DE-1000LP Centrifuge Variable Frequency Drive

Issued 15 Jan 11 **Rev. 01 Jan 14**

Maintenance & Operation Manual

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Derrick Corporation has taken care to ensure that all of its maintenance and operation manuals are accurate. However, we offer no guarantees or warranties in this regard. Our manuals are provided only as a guide to assist with the maintenance and operation. Derrick Corporation takes no responsibility for any losses, damage, or injuries that may occur as a result of using any of our manuals.

It is ultimately the operator's responsibility to ensure that the operation, repair, and maintenance of equipment complies with all applicable national and local regulations, including safety regulations.

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Derrick Equipment Company
15630 Export Plaza Drive
Houston, Texas 77032
Phone: 281.590.3003
Toll Free: 1.866.DERRICK
Fax: 281.442.6948
www.derrickequipment.com

UNIT NUMBER IS KEY TO DERRICK SERVICE

All inquiries to Derrick must include the equipment unit number. The stainless steel unit number tag attached to each piece of Derrick equipment is your key to efficient service and support.

Typical Derrick Unit Number

This unique number gives vital information to Service personnel who use it to identify the correct parts when filling orders, provide accurate responses to service questions, track documentation, and trace the equipment's history or configuration. In short, the **unit number provides the critical information needed to ensure that Derrick customers receive the best possible service**.

The unit number consists of a two-character alphabetic prefix that identifies the equipment type and a series of numeric characters that signify the sequence of the machine's manufacture. For example, unit number MA000001 would be the first screening machine manufactured by Derrick. Alphabetic prefixes currently in use are:

MA - Screening Machine	AD - Desilter and Desander
DG - Degasser	AG - Mud Agitator
CF - Centrifuge	SF - Screen Frame

To ensure that it will remain intact over many years of rigorous service, the heavy-gage tag is riveted to a structural member such as the shaker support structure. It is not to be confused with any other identifier on the machine such as a vibrator motor serial number.

For convenient availability, the unit number is also recorded in the Operation and Maintenance manual shipped with the equipment. When contacting Derrick for any equipment question or need, always have the unit number in your possession. It's the best way to get the most efficient service from our dedicated Service and Engineering personnel.

ABOUT THIS MANUAL

In this electronic manual, all sections and paragraphs listed in the CONTENTS are linked to the corresponding text.

Navigate the electronic manual as follows:

1. **To view any desired information, display the CONTENTS page and move the cursor to the desired paragraph or section title.**
2. **To display the desired information, click on the listing when the pointing finger appears over the text.**
3. **When finished viewing the text, press Alt + left arrow key to return to the CONTENTS page.**
4. **If desired to return to the same information, press Alt + right arrow. To locate a different item, repeat steps 1 and 2.**
5. **Blank pages are included to facilitate accurate two-sided printing on a standard copier. To print any individual section, simply enter the PDF page number range at the top of the screen (not the page number at the bottom of each page).**

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Continuous improvement is a policy of Derrick Corporation. All instructions and procedures are subject to change without notice.

CONTENTS

Section	Page	Date
1 - Introduction	**1-1**	**15 Aug 13**
Overview	1-1	
Safety	1-1	
Sound Emission	1-1	
Equipment Use	1-2	
Description	1-2	
Mechanical Operation	1-6	
Control System	1-7	
Product Support	1-8	
2 - Safety	**2-1**	**30 Sep 13**
General	2-1	
Warnings	2-1	
Material Safety Data Sheets (MSDSs)	2-3	
3 - Installation	**3-1**	**30 Sep 13**
General	3-1	
Safety	3-1	
Top Cover Opening/Closing Procedures	3-2	
Installation Sequence	3-3	
Site Preparation and Clearance Requirements	3-2	
Equipment Handling	3-3	
Equipment Leveling	3-4	
Lower and Secure Rotating Assembly	3-4	
Feed and Discharge Connections	3-6	
Compressed Air	3-6	
Feed Pump	3-6	
Electric Power Connections	3-7	
Polarity Test	3-9	
Machine Startup	3-9	

CONTENTS

Section	Page	Date
4 - Operating Instructions	**4-1**	**30 Sep 13**
General	4-1	
Software Version	4-1	
Operating Safety	4-1	
Top Cover Opening/Closing Procedures	4-2	
Cold Climate Startup	4-2	
Purge System (Hazardous Environment Only)	4-2	
Initial Startup	4-4	
Normal Startup	4-6	
Operation	4-7	
Alarm and Fault Messages	4-11	
Bearing Temperatures	4-11	
Motor Torque Trend	4-12	
System Diagnostics	4-12	
Performance Status	4-13	
Alarms	4-14	
VFD Status	4-15	
Pump VFD Fault Status	4-16	
Temperature Trends	4-17	
VFD Fault Reset	4-17	
Setup Screen	4-18	
Pump Setup	4-18	
Login	4-19	
Clean Out	4-19	
Normal Shutdown	4-20	
Automatic Shutdown	4-21	
Emergency Shutdown	4-21	
5 - Maintenance	**5-1**	**01 Jan 14**
General	5-1	
Top Cover Opening/Closing Procedures	5-1	
Preventive Maintenance	5-2	
Lubrication Chart	5-4	
Drive Belt Replacement	5-4	
Purge System	5-5	
Rotating Assembly Maintenance	5-9	
Tool List	5-14	
Hardware Torque Specifications	5-15	

Section	Page	Date
5 - Maintenance (Cont'd)		
Recommended Spare Parts	5-18	
Troubleshooting	5-21	
Alarm and Fault Messages	5-29	
VFD Alarm and Fault Cross References	5-36	
Control Component indicators	5-37	
6-7 - Not Used		
8 - Reference Drawings	**8-1**	**15 Jan 11**
9 - Installation and Maintenance Log	**9-1**	**15 Jan 11**
Appendix A - HMI Server System		**15 Feb 13**

SECTION 1 - INTRODUCTION

OVERVIEW

This manual provides instructions for installing and operating the DE-1000LP Variable Frequency Drive (VFD) centrifuge (Figure 1-1). The manual is divided into several sections to assist the user in readily accessing the information. Personnel responsible for transporting, installing, operating, or performing maintenance on this equipment are required to read and understand the information and instructions in this manual. One copy of this manual should be available and accessible at the equipment location.

For maximum safety and performance, no additions and/or changes may be made to the equipment without the explicit written permission of Derrick Corporation. Genuine Derrick repair/replacement parts are required.

Figure 1-1. DE-1000LP Variable Frequency Drive (VFD) Centrifuge

SAFETY

Section 2 of this manual contains relevant safety information for both operation and maintenance of this equipment. Be sure this information is read and understood by all personnel.

DO NOT operate the equipment if defective or faulty mechanical or electrical components are detected.

SOUND EMISSION

Hearing protection is recommended when working on or near the centrifuge. Based on measurements taken for technically comparable machinery, the centrifuge emits the following airborne sound levels:

- A-Weighted Machine Surface-Averaged Sound Pressure Level at 1m - 86 dBA
- A-Weighted Machine Surface-Averaged Sound Power Level - 102 dBA
- C-Weighted Instantaneous Peak Sound Pressure Level - 106 dBA

EQUIPMENT USE

The DE-1000LP VFD centrifuge is designed expressly for removing low and high specific gravity solids from slurries. In one type of processing, solids are removed and the liquid is returned for recirculation. Alternatively, solids are returned to the active system and the liquid is discarded.

Derrick Corporation does not authorize any other use of this equipment. Intended usage of the equipment includes compliance with the operating, maintenance, and safety procedures included in this manual.

DESCRIPTION

Major components of the centrifuge (Figure 1-2) consist of the rotating assembly, control cabinet, bowl and conveyor drive motors, operator control panel (HMI), purge system, vibration switch, and case, base assembly, and skid. The following paragraphs describe these components.

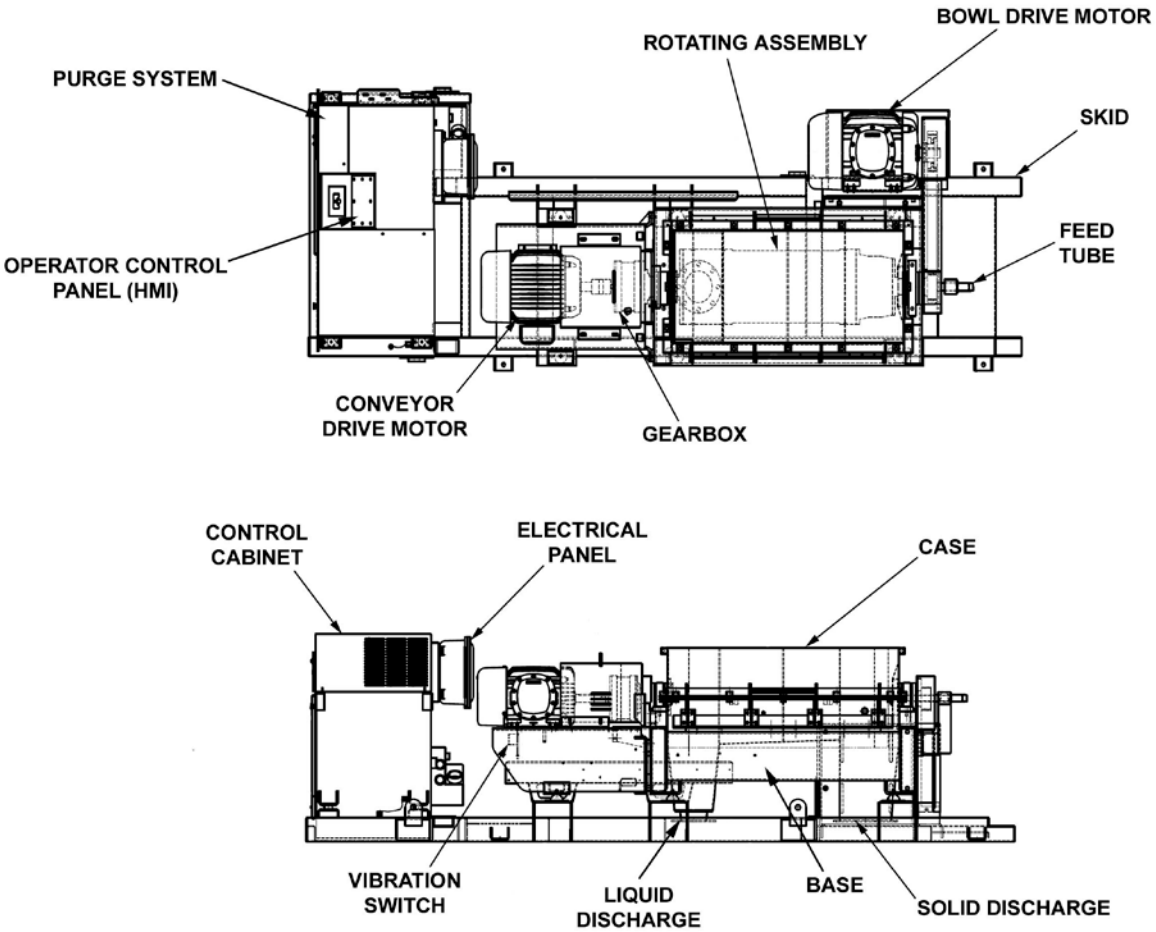


Figure 1-2. DE-1000LP VFD Centrifuge Major Components

Rotating Assembly

The rotating assembly consists of a cylindrically shaped stainless steel bowl, conveyor assembly, and related components. The bowl consists of a straight stainless steel cylinder with a conical section at the discharge end and a flat liquid bowl head at the opposite end. Openings are provided at both ends to permit liquid and solid discharges. The bowl ends are supported by roller bearings having grease fittings to facilitate periodic lubrication.

Bowl Assembly

The liquid bowl head at the liquid discharge end contains movable effluent ports that permit manual adjustment of the liquid level remaining in the bowl during rotation. Index marks are provided on the weirs to facilitate precise adjustment. The liquid level or pond depth, along with other factors, helps determine the liquid content of the discharged solids. The conical bowl at the solids end forms an upward sloping beach, where solids collect and are continuously discharged through the solids discharge outlet. Replaceable wear inserts installed in the solid bowl head protect the openings from wear.

Conveyor

The conveyor assembly is a hollow, cylindrical auger that receives the inlet slurry into its interior, disperses it through feed nozzles to the bowl assembly, and transports the solids to the solids discharge outlet. Rotated by an electric motor through a differential gearbox, the conveyor turns in the same direction as the bowl but at a slower rate of speed. The differential speed setting on the control panel determines the conveyor speed in relation to the bowl speed. This relationship remains consistent; as bowl speed is varied, the conveyor speed varies commensurately but maintains the differential relationship. For example, a bowl speed of 2000 RPM and a conveyor differential speed of 10 results in the conveyor rotating at a rate of 1990 RPM.

A drive shaft extending through the bowl head transfers motion from the gearbox to the conveyor. The feed tube inserted through the conveyor at the solids end directs inlet slurry against a feed accelerator, which rapidly disperses the material through feed nozzles in the conveyor. Carbide inserts are installed in the feed nozzles, and carbide tiles are welded to the edges of the conveyor flights for wear resistance. Ball bearings support both ends of the conveyor.

Gearbox

The 52:1 ratio differential reduction gearbox rotates the conveyor at a slower speed than the bowl assembly. The motor is coupled to the gearbox by a flexible coupling, which permits compliance with slight alignment variations. The conveyor's rotational speed varies directly with bowl speed, maintaining a consistent differential relationship for solids conveyance.

The gearbox is an overhung load with one end supported by the liquid end conveyor bearing. The gearbox output shaft, driven by the second-stage planetary gears, engages internal splines in the conveyor to transmit rotary motion.

During an overload condition excessive solids in the conveyor may overburden the motor, causing motor torque to increase as it attempts to maintain the differential speed setting. If the conveyor's pre-set torque limit is reached, the control system automatically reduces the feed rate to enable the conveyor to clear the excess solids. When the centrifuge is operating at the reduced feed rate, the Operation screen displays a message to inform the operator of the modified status. Unless the over-torque condition is removed, the centrifuge will be shut down automatically.

Drive Motors

The centrifuge is powered by two inverter-duty 1800 RPM, three-phase, explosion-proof electric motors. The 50 HP bowl drive motor is transmitted to the bowl assembly by a sheave and series of drive belts, while the conveyor is directly coupled to a 20 HP electric motor. A protective guard covers the sheaves, drive belts, and conveyor drive flexible coupling for personnel protection.

Control Cabinet

The control cabinet is used to start, operate, and shut down the centrifuge. All operating controls and sensing system components needed for centrifuge operation are installed in the cabinet. The cabinet consists of a steel enclosure having a hinged front door. Several twist-lock fasteners retain the door securely closed, and a gasket surrounding the outer edge of the door provides a weather-tight seal for protection of the interior electrical and electronic components. Fittings are installed at the rear of the cabinet to permit entry of power and sensing cables.

Variable frequency drives (VFDs), a programmable logic controller (PLC), intrinsically safe barriers, terminal blocks, fuses, and other electrical components are installed in the cabinet. An air-conditioning unit is used to maintain a suitable ambient environment for operation of the electrical equipment, and an automatic purge system maintains a positive internal pressure to prevent entry of hazardous vapors. The purge system turns on electric power to the cabinet components only after thorough evacuation of flammable gases from the control cabinet interior.

The operator control panel and mouse are installed on the front of the cabinet above the door. An emergency stop button to the right of the control panel permits instantaneous shutdown of VFDs (motor drives) in case of emergency.

A thermostatically controlled space heater is installed in the cabinet to warm the interior before power is applied to the electrical components. The heater ensures that the interior temperature remains at a minimum of 40°F (4.4°C).

For centrifuges installed in hazardous environments, a purge system provides a continuous flow of air to prevent the cabinet interior from accumulating explosive vapors. When power is applied to the centrifuge, the cabinet purge system initiates a 16-minute rapid purge cycle at 16 CFM. This cycle consists of five complete air exchanges. When the rapid purge cycle is completed, the purge system automatically closes a switch that supplies power to the cabinet. During centrifuge operation, the purge system maintains a continuous flow of air to provide positive pressure within the control cabinet to prevent entry of flammable gas. Minimum pressure and purge flow sensors provide an output signal to the PLC if the purge system is not maintaining satisfactory pressure within the cabinet. For further details of purge system operation, refer to Section 4.

Cabinet Purge System

Before power is applied to the centrifuge, the purge system purges the control cabinet of any flammable gas that may have entered the cabinet while it was not pressurized. The system also maintains positive pressure and automatically compensates for any leakage within the control cabinet to prevent entry of flammable gas. The system has FM, UL, ATEX, and IECEx certifications.

The purge unit has a visual indication of purge system status. Minimum pressure and purge flow sensors provide an output signal to the control unit if the purge system is not maintaining satisfactory pressure within the cabinet. Major components of the purge system are described in the following paragraphs.

Control Unit

The control unit contains a pneumatic logic circuit that controls the cabinet purge and pressurization. It receives filtered air from an external air filtration system installed on the outside of the control cabinet. Components installed in the control unit include air filtration, pressure and purge flow measurement, purge timing, and local visual indication of pressurized/alarm and flow sensed. It also provides the required output to turn on power to the cabinet.

Relief Valve (RLV)

The relief valve unit is installed on the left side of the control cabinet to provide a means of limiting the maximum pressure experienced by the cabinet during operation. The relief valve incorporates a spark arrestor to prevent sparks from being ejected from the cabinet into the hazardous area. The relief valve is combined with the flow measurement mechanism to provide feedback to the control unit.

Leakage Compensation Operation

Initially, a high flow of protective gas is passed into the control cabinet (Figure 1-3). This flow is verified and performs the purging phase of the operation. When the purge time has elapsed, the flow of protective gas is controlled by an adjustable leakage compensation valve. In addition to maintaining pressurization, this valve compensates for any leakage from the cabinet. For proper functioning of the leakage compensation valve, leakage from the cabinet must exceed 5 l/min. Insufficient leakage will cause the relief valve to cycle open and closed continuously.

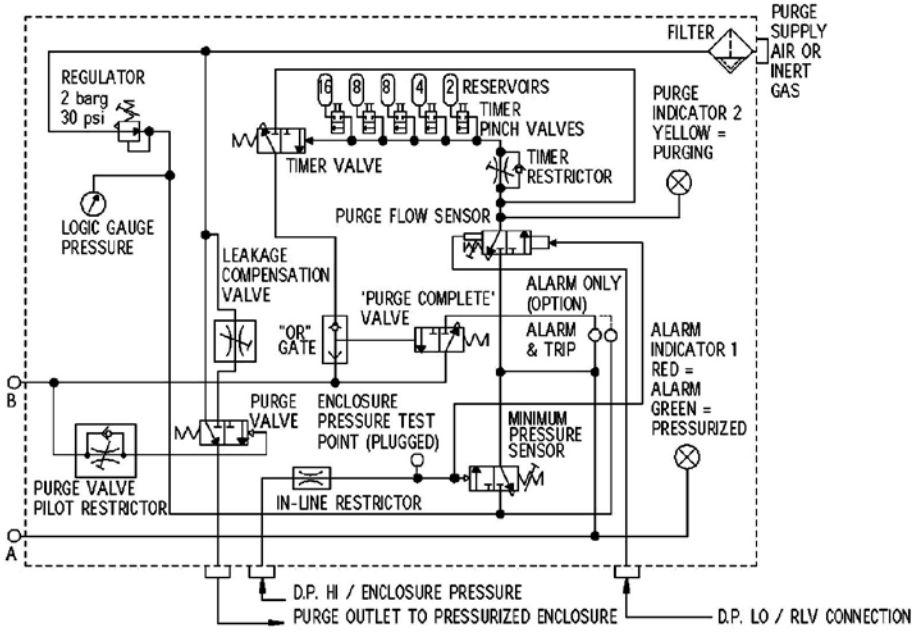


Figure 1-3. Leakage Compensation Circuit Schematic Diagram

Output Signal

The purge system provides an intrinsically safe power output. This output consists of a low-voltage electrical lead connected from the purge unit to an intrinsic barrier in the electrical panel. When the purging phase is completed, this output signal closes the main contactor in the electrical panel, which then energizes all components in the control cabinet.

Vibration Switch

The vibration switch (Figure 1-4) is a safety device designed to protect personnel and equipment by shutting down the centrifuge in case of excessive vibration. Normally, the switch contacts are held closed by a mechanical latch. However, strong vibration or a shock of 2 Gs will overcome the magnetic latch, causing the switch armature to break away from the normally closed position, providing an input to the PLC.

Vibration Switch (Cont'd)

A reset button on the side of the switch must then be manually pressed to close the contacts and re-engage the magnetic latch. The vibration trip level is adjustable by means of a set point control, which adjusts the air gap between the magnet and latch arm plate. Turning the screw counterclockwise reduces the vibration set point in terms of G force needed to trip the armature. When the control is turned fully clockwise, the switch will trip at the maximum rated vibration level.

The vibration switch is mounted on the centrifuge base in an orientation that is most affected by out-of-balance vibration of the bowl assembly. Clogging of the conveyor or worn bearings may produce sufficiently high vibration to trip the switch.

Figure 1-4. Vibration Switch

Case, Base, And Skid

The stainless steel upper and lower case halves provide a sealed, protective enclosure that fully surrounds the bowl assembly. The liquid discharge pipe and the solid discharge chute are installed at the bottom of the lower case half. Mating baffles installed inside the top and bottom case halves separate the solids and liquid. Bolts secure the top and bottom halves together, and a rubber gasket in the top case seals the two halves. A separate, two-piece enclosure encloses the gearbox at the liquid end of the bowl assembly.

The case is bolted onto the welded steel base assembly, which contains mounting provisions for the bearing pillow blocks and feed tube support. The base assembly is bolted to the welded steel skid.

MECHANICAL OPERATION

The centrifuge receives slurry at the sheave end (solid discharge end) of the machine. For best performance, the slurry should be screened to 74 microns in vibrating screening machines before being fed to the centrifuge.

The slurry flows through a feed tube into the rotating bowl, where centrifugal force separates liquid from the solids. Liquid flows out the liquid discharge connection at the gearbox end of the centrifuge, while solids are conveyed to the solid discharge where they fall into a chute at the bottom of the machine.

The centrifuge is configured to operate on a specific AC voltage supplied in three-phase, 50Hz or 60Hz. Electrical controls are mounted on the electrical control box located at the machine's liquid discharge end. Safety devices built into the centrifuge protect personnel and equipment by shutting down the machine in case of excessive bowl or conveyor torque, high motor temperature, vibration, or other malfunction. G forces produced by the high-speed rotation of a cylindrical bowl separate solids from the feed slurry.

Centrifuge performance is based on three variable factors:

- G force exerted on the fluid - Gravitational force pulling fluid against the outside wall of the centrifuge
- Retention time in the centrifuge - The longer the slurry remains in the centrifuge the smaller the particle that can be separated
- Differential speed of conveyor - The faster the conveyor rotates, the wetter the solids and the more solids that are discharged

All three factors may be manipulated to alter the liquid and solids discharge. Retention time is controlled by adjusting the liquid discharge ports on the liquid bowl head to change the pond depth (liquid level). G-force is adjusted by changing the bowl speed on the operator control panel, and the conveyor differential speed may be altered by changing the differential speed setting on the control panel. The conveying speed is the difference between the bowl and conveyor speeds. Adjusting the pond depth requires shutdown of the equipment. Another method of altering the discharge results is to change the feed rate.

During centrifuge operation, slurry is pumped through the feed tube into the center of the rotating conveyor (Figure 1-5), where it splashes against the feed accelerator. The high velocity slurry is then dispersed out four feed nozzles in the periphery of the conveyor cylinder. Rotating at a higher speed than the conveyor, the bowl creates an additional shearing effect, which further increases the slurry's acceleration.

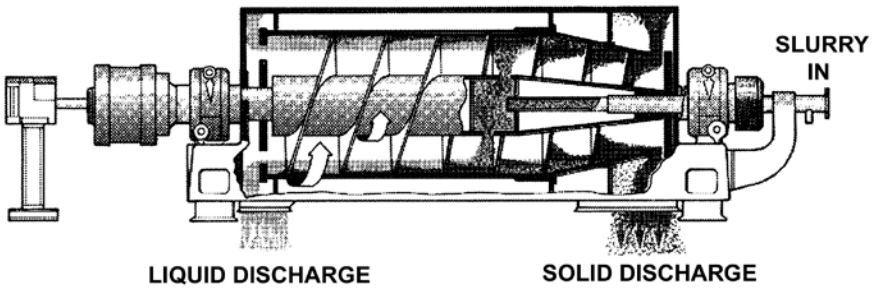


Figure 1-5. Centrifuge Mechanical Operation

As the slurry flows in the channels between the conveyor flights, the heavy particles settle at an accelerated rate due to the G force imposed by the rotating bowl. Sand particles settle almost instantly; then the finer, lighter particles settle. Particles that cannot be settled under the present settings will be discharged with the liquid through the adjustable weirs on the liquid bowl head. Liquid exiting the liquid bowl head is directed through the liquid discharge outlet.

The settled solids form a cake inside the bowl and are transported by the conveyor toward the narrow end of the bowl (beach). As the solids travel across the beach, their free liquid film is lost due to centrifugal squeezing and drainage. When they are discharged at high velocity through the solid discharge ports on the bowl, they contain only the adsorbed moisture.

CONTROL SYSTEM

Centrifuge operation is supervised by a PLC that interfaces with the VFDs supplying power to the bowl, conveyor, and feed pump drive motors. Monitoring and control of the centrifuge may be performed locally or up to thousands of miles away. The environmentally hardened PLC also offers short-term data storage and a high degree of operating flexibility. The graphical color interface mounted on the control cabinet facilitates communication with the VFDs and provides real-time access to system operating characteristics. Through the control panel, the operator may start the centrifuge, enter and adjust bowl and conveyor speeds, set feed rate, and shut down the machine.

Various inputs including main bearing temperatures, bowl speed, bowl and conveyor torques, cabinet interior temperature, and vibration are transmitted to the PLC, which then responds with corresponding outputs to govern centrifuge operation. Critical status information is displayed on the control panel, as well as alarm and fault messages that signal the operator of any potential or imminent malfunctions. Any excessive variation from a pre-set limit causes the PLC to automatically shut down the centrifuge and display an explanatory message for the cause of the shutdown. In addition, emergency shutdown may be performed by the operator at any time from the front panel.

The positive-displacement feed pump is fully controlled by the PLC in either manual or automatic operation. Automatic operation provides maximum throughput, as the optimum feed rate is assured by the PLC under varying operating conditions. Feed is automatically increased until the pre-set torque limit is reached by either the bowl or conveyor drive motor. If feed slurry properties change, the feed rate is automatically adjusted to remain within the torque limit.

PRODUCT SUPPORT

Derrick Corporation offers 24-hour per day, 7-day per week product support. Product support includes screen replacement / ordering information and repair / replacement parts and service for the entire product line. Refer to the following table for the parts / service center nearest you.

PARTS SALES & SERVICE LOCATIONS
Colorado
Grand Junction - 970.241.2417
Louisiana
Broussard - 877.635.3354
New York - Corporate Headquarters
Buffalo - 716.683.9010
Oklahoma
Oklahoma City - 405.208.4070
Texas
Houston (Oilfield Headquarters) - 866.DERRICK (337.7425) • 281.590.3003
North Texas (Bridgeport) - 405.208.4070
South Texas (Corpus Christi) - 361.299.6080
West Texas (Midland) - 405.397.4089
East Texas, Arkansas, and Louisiana - 281.546.1166
Wyoming
Casper - 307.265.0445
North Dakota
Williston - 701.572.0722

SECTION 2 - SAFETY

GENERAL

This section contains a summary of WARNINGS used in this manual and a list of material safety data sheets (MSDSs) applicable to the equipment. The centrifuge has been designed to perform the stated functions safely.

WARNINGS

All persons responsible for operation and maintenance of this equipment must read and understand all safety information in this manual prior to operating and/or maintaining the equipment. The safety warnings listed below are included in applicable procedures throughout this manual.

Work Area

	WARNING! ALWAYS BE AWARE OF WORK AREA HAZARDS TO PROTECT AGAINST SLIPS, TRIPS, AND FALLS WHEN WORKING ON OR NEAR THIS EQUIPMENT.
	WARNING! LOUD NOISE! WEAR HEARING PROTECTION AT ALL TIMES WHEN WORKING ON OR NEAR THIS EQUIPMENT.
	WARNING! VISION HAZARD! SAFETY GLASSES MUST BE WORN AT ALL TIMES WHEN WORKING ON OR NEAR THIS EQIPMENT TO PREVENT SERIOUS EYE INJURY OR PERMANENT LOSS OF VISION.

Electrical Hazards

	DANGER! HIGH VOLTAGE! SHUT DOWN, LOCK OUT, AND TAG OUT ELECTRIC POWER, AND ENSURE THAT EQUIPMENT HAS STOPPED ROTATING BEFORE WORKING ON THIS EQUIPMENT.
	WARNING! DRIVE MOTOR MUST BE OPERATED AT THE DESIGNATED SUPPLY VOLTAGE.
	WARNING! ELECTRICAL CONNECTIONS MUST BE MADE IN ACCORDANCE WITH ALL APPLICABLE NATIONAL AND LOCAL CODES. FAILURE TO COMPLY MAY RESULT IN AN UNSAFE CONDITION THAT COULD INJURE PERSONNEL OR DAMAGE EQUIPMENT. ENSURE THAT ALL ELECTRICAL AND CONDUIT CONNECTIONS ARE SECURE.
	WARNING! DO NOT BYPASS PURGE SYSTEM IF NOT CERTAIN THAT ENVIRONMENT IS NON-HAZARDOUS. A HIGH RISK OF FIRE AND/OR EXPLOSION WILL RESULT IF PURGE SYSTEM IS BYPASSED IN A HAZARDOUS AREA.

Electrical Hazards (Cont'd)

	DANGER! USE EXTREME CAUTION WHEN OPERATING CENTRIFUGE WITH PURGE SYSTEM BYPASSED. DANGEROUSLY HIGH VOLTAGE WILL BE PRESENT IN CONTROL CABINET IF DOOR IS OPENED WHILE POWER IS APPLIED.

Equipment Handling

	WARNING! USE SPREADER BARS TO PREVENT DAMAGE WHEN LIFTING THE EQUIPMENT.
	WARNING! TO ENSURE PROPER BALANCE AND ORIENTATION WHEN UNIT IS RAISED AND PREVENT DAMAGE TO COMPONENTS, ATTACH LIFTING SLING ONLY AT DESIGNATED LIFT POINTS. DO NOT ATTEMPT LIFTING BY ATTACHMENT TO MOTOR OR ANY OTHER LOCATION.
	WARNING! BE SURE THAT HANDLING DEVICES HAVE SUFFICIENT LIFTING CAPACITY TO SAFELY HANDLE THE WEIGHT OF THE EQUIPMENT.
	WARNING! DO NOT REMOVE SHIPPING BRACKETS UNTIL EQUIPMENT HAS BEEN POSITIONED AT FINAL INSTALLATION SITE.
	WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO HANDS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

Operation

	WARNING! ALL OPERATING AND MAINTENANCE PERSONNEL MUST READ AND UNDERSTAND ALL SAFETY INFORMATION IN THIS MANUAL BEFORE WORKING WITH THE EQUIPMENT.
	WARNING! BE SURE THAT TOP COVER IS CLOSED AND SECURED AND ALL PERSONNEL ARE CLEAR BEFORE STARTING MACHINE.
	WARNING! BEFORE STARTING CENTRIFUGE, BE SURE THAT ALL SHIPPING BRACKETS HAVE BEEN REMOVED AND BEARING PILLOW BLOCKS ARE PROPERLY TIGHTENED.
	WARNING! ALWAYS ALLOW MACHINE TO COAST TO A COMPLETE STOP BEFORE OPENING TOP COVER OR REMOVING GUARDS.
	WARNING! DO NOT OPERATE CENTRIFUGE IF EXCESSIVE NOISE OR VIBRATION DEVELOPS. ALWAYS CONFIRM THAT VIBRATION SWITCH AND OTHER SAFETY DEVICES ARE FUNCTIONAL.

WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO HANDS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

Maintenance

DANGER! HIGH VOLTAGE! SHUT DOWN, LOCK OUT, AND TAG OUT ELECTRIC POWER, AND ENSURE THAT EQUIPMENT HAS STOPPED ROTATING BEFORE WORKING ON THIS EQUIPMENT.

WARNING! TWO OPERATORS ARE REQUIRED TO SAFELY OPEN AND CLOSE COVER, USING BOTH HANDS TO FULLY SUPPORT COVER THROUGHOUT TRAVEL.

Storage

WARNING! CENTRIFUGE MAY BE DAMAGED BY STORING IN A HIGH HUMIDITY ENVIRONMENT (GREATER THAN 50% RH). EQUIPMENT MUST BE STORED IN A LOW-HUMIDITY ENVIRONMENT.

MATERIAL SAFETY DATA SHEETS (MSDSs)

Material Safety Data Sheets (MSDSs) advise personnel of the properties and any possible hazards associated with these materials. Emergency first aid procedures, special precautions, emergency telephone number, and other relevant data are contained in the MSDSs. These documents are prepared by the product manufacturers, which have sole responsibility for accuracy of the information.

The MSDSs listed below apply to products used in the manufacture of the Derrick equipment. Where shown, dates are current as of the publication date of this manual. The latest MSDSs may be obtained from the product manufacturer.

MATERIAL DESCRIPTION / WHERE USED	MSDS No. / Date
Paints	
PPG Dimetcote 302H Green 302F0250 Resin / Top Coat	1302H-5A / 04-11-10
PPG Dimetcote 302H Clear 302G0910 Cure / Top Coat	1302H-B / 01-21-10
PPG PSX 700 Neutral Tint Resin / Undercoat	PX700T3 / 02-28-08
PPG PSX 700FD Cure / Undercoat	PX700FD-B / 01-11-07
Lubricants	
Standard Environment	
Chevron SRI NLGI 2 / Main, Conveyor, & Motor Bearings	*6979* / 08-03-04
Shell Omala 320 / Gearbox	67510E / 07-08-08
Shell AeroShell 14 / Main & Conveyor Bearings	*56200E-9* / 07-07-08

MATERIAL DESCRIPTION / WHERE USED	MSDS No. / Date
Arctic Environment	
Shell AeroShell 7 / Drive Motor Bearings	56170E-9 / 05-20-03
Exxon Mobil Mobilith SHC 220 / Gearbox	Mobilith SHC 220 / 03-23-10
Food Grade	
Chevron SRI NLGI 2 / Main, Conveyor, & Motor Bearings	*6979* / 08-03-04
Exxon Mobil FM 102 / Conveyor Bearings Only	*642363-00* / 01-17-02
Shell Omala 320 / Gearbox	67510E / 07-08-08
Sealant	
Loctite Anti-Seize Lubricant / Fasteners	76764 / 05-27-09

SECTION 3 - INSTALLATION

GENERAL

This section describes the recommended installation procedure for the Derrick equipment defined by the model number and drawing number associated with your equipment. The centrifuge is shipped fully assembled. For safety during shipment, however, the rotating assembly is supported by shipping brackets. It must be lowered onto the base and then its bearing pillow blocks secured to the base.

SAFETY

Read and understand **ALL** safety information presented in this manual **before** installing and operating this equipment. Refer to Section 2 for a summary of Warnings addressing installation, operation, and maintenance of this equipment.

Before beginning the installation, review the equipment handling procedures in this section. Note particularly the information concerning “lift points” and the use of spreader bars before lifting or moving the equipment.

Failure to observe proper equipment handling procedures may result in serious personal injury or death and/or damage to the equipment.

	WARNING! TO ENSURE PROPER BALANCE AND ORIENTATION WHEN UNIT IS RAISED AND PREVENT DAMAGE TO COMPONENTS, ATTACH LIFTING SLING ONLY AT DESIGNATED LIFT POINTS. DO NOT ATTEMPT LIFTING BY ATTACHMENT TO ANY OTHER LOCATION.
	WARNING! BE SURE THAT HANDLING DEVICES HAVE SUFFICIENT LIFTING CAPACITY TO SAFELY HANDLE THE WEIGHT OF THE EQUIPMENT. LOWER THE CENTRIFUGE GENTLY INTO PLACE, AS JARRING MAY CAUSE DAMAGE.
	WARNING! DO NOT REMOVE SHIPPING BRACKETS UNTIL CENTRIFUGE HAS BEEN POSITIONED AT FINAL INSTALLATION SITE.
	WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO OPERATORS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

TOP COVER OPENING/CLOSING PROCEDURES

The proper procedures for opening and closing the top cover of the centrifuge must always be followed. Two operators using both hands are required to open the cover. Derrick recommends having a hoist available if additional assistance is desired during the opening/closing of the centrifuge cover. To open and close the cover, proceed as follows:

1. Shut down, lock out, tag out electric power to centrifuge, and allow rotating assembly to coast to a full stop.
2. Remove bolts securing cover to base.
3. Have two operators using both hands grip the cover handles securely to ensure full control of the cover throughout the opening and closing process.
4. As the cover is raised, ensure that body limbs of all personnel and any other items remain clear of the cover gap at all times.
5. Raise the cover to the fully opened position, and insert a 1/2" (12.7mm) hardened steel pin through one hinge to lock the cover open.
6. After performing the activity that required the cover to be opened, reverse steps 2 through 5 to close the cover. During the closing procedure, ensure that both operators are capable of controlling the cover's descent and that all body limbs and other items remain clear of the gap.

INSTALLATION SEQUENCE

Following is the sequence of steps for installing the centrifuge. The sequence presented may vary depending on the user's facilities and previous experience with this type of equipment.

1. Read and understand all safety information in Section 2 before installing and operating this equipment.
2. Read and understand the equipment handling procedures in this section before lifting and moving the equipment.
3. Position and level equipment at installation site.
4. Remove shipping components, and lower and secure the rotating assembly to the base.
5. Adjust drive belt (refer to Section 5).
6. Connect liquid discharge line.
7. If discharge duct is to be used, connect duct to solids discharge chute.
8. Connect flexible lines to inlet feed and flushing flanges.
9. Connect electric power supply to the equipment, and connect feed pump to terminals of feed pump controller.
10. Refer to Section 4 for startup and operating procedures.

SITE PREPARATION AND CLEARANCE REQUIREMENTS

Prior to placement of equipment, verify that electricity is available at the equipment site and that feed line and discharge chute (if any) are provided. Also ensure that clearances around the equipment are adequate. Prepare the installation site as follows:

1. Provide adequate clearances to perform the following activities:
   a. Operate controls on electrical panel
   b. Open and close the control cabinet door (Figure 3-1).

c. Open and close top cover.
d. Grease main and gearbox bearings.
e. Check and fill gearbox.
f. Connect and disconnect feed and discharge lines.

2. Confirm that mounting structure is properly positioned and adequate to support the weight of the centrifuge.
3. Verify that electric power supply available at the site matches the centrifuge power requirements.
4. Check that liquid discharge line flange matches the liquid discharge connection on the machine.

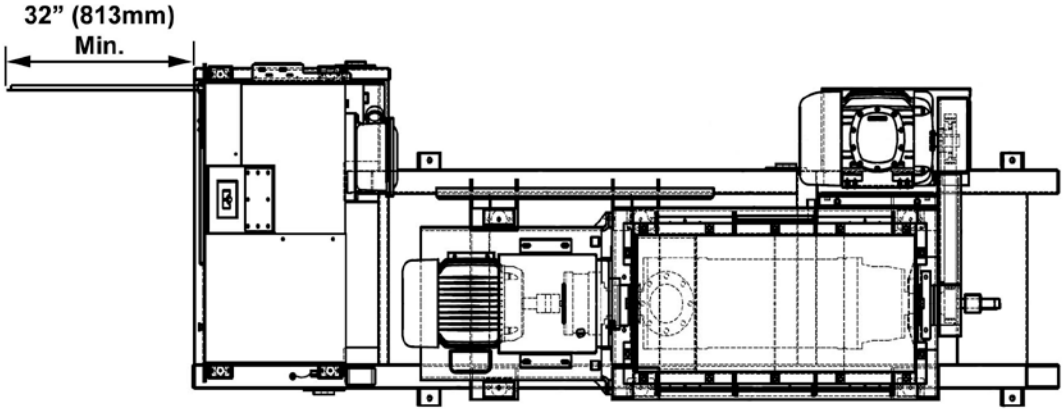


Figure 3-1. Required Control Cabinet Door Clearance

EQUIPMENT HANDLING

⚠	**WARNING! USE SPREADER BARS TO PREVENT DAMAGE WHEN LIFTING THE EQUIPMENT.**
⚠	**WARNING! TO ENSURE PROPER BALANCE AND ORIENTATION WHEN UNIT IS RAISED AND PREVENT DAMAGE TO COMPONENTS, ATTACH LIFTING SLINGS ONLY TO LABELLED LIFTING POINTS. DO NOT ATTEMPT LIFTING BY ATTACHMENT TO ANY OTHER LOCATION.**
⚠	**WARNING! BE SURE THAT HANDLING DEVICES HAVE SUFFICIENT LIFTING CAPACITY TO SAFELY HANDLE THE WEIGHT OF THE EQUIPMENT.**
⚠	**WARNING! DO NOT REMOVE SHIPPING BRACKETS UNTIL EQUIPMENT HAS BEEN POSITIONED AT FINAL INSTALLATION SITE.**
⚠	**WARNING! WHEN USING AN OVERHEAD LIFTING DEVICE, USE ALL FOUR LIFTING POINTS PROVIDED.**

The centrifuge is shipped fully assembled and installed on a shipping skid. A label indicating the weight of the unit was affixed to the machine. Refer to the general arrangement drawing in Section 8 for equipment weight and other technical data.

While the centrifuge is still mounted on the shipping skid, it may be transported on the ground using a forklift. After the machine is removed from the shipping skid, an overhead lifting device is required.

Four reinforced lifting lugs are built into the equipment frame to allow attachment of an overhead-lifting device (Figure 3-2). Lifting points are labeled **"LIFT HERE ONLY"**. **DO NOT** attempt lifting equipment by attaching slings or similar lifting aids to the electric motor or other non-designated portions of the unit. Use of spreader bars is recommended.

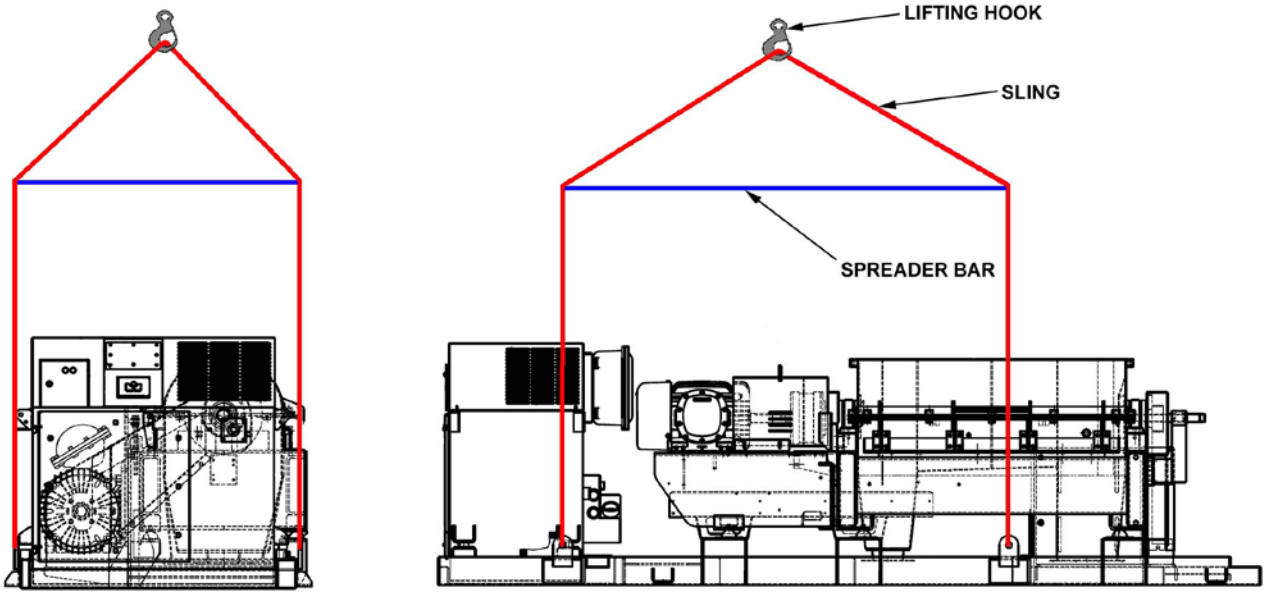


Figure 3-2. Lifting Arrangement

EQUIPMENT LEVELING

The centrifuge must be properly leveled for satisfactory operation. The equipment must be leveled along the length and width of the unit (Figure 3-3). A 2-foot or torpedo level is recommended. Non-compressible shims should be used as required to level the machine.

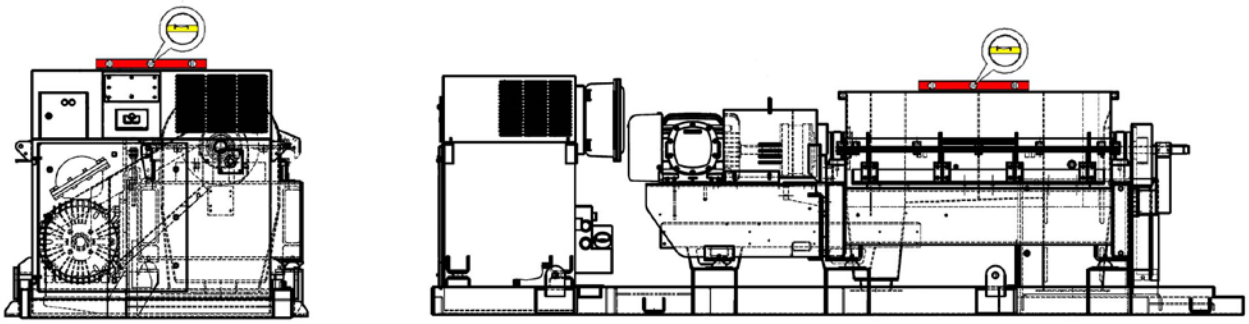


Figure 3-3. DE-1000LP VFD Centrifuge Leveling

LOWER AND SECURE ROTATING ASSEMBLY

Note! Retain shipping brackets that support rotating assembly after removal. The brackets must be re-installed whenever the machine is moved, as they prevent damage to the rotating assembly bearings during transit.

Shipping brackets prevent bearing damage during transit, and rubber strips protect the pillow block mounting surfaces. After final positioning and leveling of the centrifuge, the shipping brackets and covers must be removed and the rotating assembly secured to the base.

Each shipping component is labeled **DISCONNECT BEFORE STARTUP**. To remove the shipping components, proceed as follows:

1. Remove belt guard and gearbox guard. Open case cover as described at the beginning of this section.
2. Release and remove two ratchet straps.
3. Using a 1-ton hoist, lift rotating assembly slowly and evenly about 5".
4. Remove shipping brackets under rotating assembly.
5. Remove rubber shipping strips under rotating assembly and bearing pillow blocks (Figure 3-4).

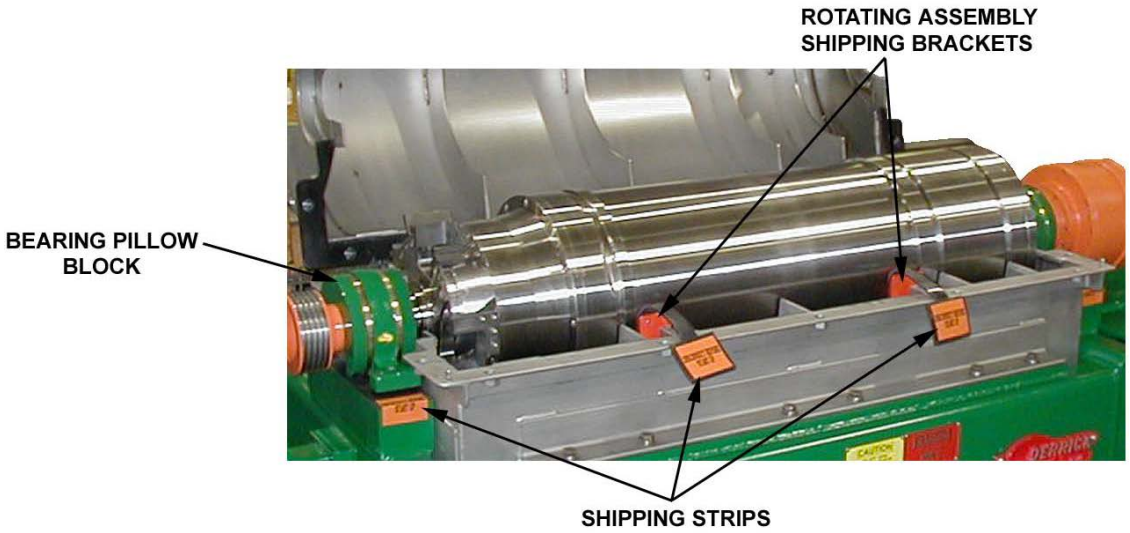


Figure 3-4. Shipping Components Locations

6. Using a suitable solvent, clean pillow block mounting surfaces and alignment pin holes. Check for and remove any nicks or burrs.
7. Slowly lower rotating assembly until pillow blocks contact base, but maintain support by hoist.
8. Apply anti-seize compound to pillow block bolts and tapered alignment pins.
9. Insert pillow block bolts and alignment pins through pillow blocks. Tap alignment pins into place.
10. Hand tighten pillow block bolts, and then release hoist. Tighten pillow block bolts in accordance with applicable torque specification in Section 5.
11. Adjust effluent ports, if necessary, from factory setting of 3.4.

WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO OPERATORS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

LOWER AND SECURE ROTATING ASSEMBLY (CONT'D)

12. Close case cover, and evenly tighten all cover bolts sequentially beginning at the center and moving toward ends.
13. Rotate bowl manually to confirm that no binding or rubbing is present.
14. Adjust drive belt tension in accordance with preventive maintenance in Section 5.
15. Install belt guard and gearbox guard.

FEED AND DISCHARGE CONNECTIONS

For vibration isolation, a flexible line must be connected to the feed tube. A source of fresh water is required for flushing the centrifuge prior to shutdown. To connect the flush line, install a tee fitting in the feed line with shutoff valves to permit selection of either the feed line or the flush line (Figure 3-5), The shutoff valves are required to prevent flush water from flowing back into the centrifuge feed.

If a customer-supplied liquid discharge line is used, the line must be flexible for vibration isolation. Since the discharge cake is very heavy and sticky because of the lack of free liquid, the centrifuge should be installed over the receptacle that is to receive the discharged solids. If this is not possible a slide or chute is needed to convey the solids. At least a 45-degree angle is required to ensure self cleaning, or a wash system must be provided to prevent material buildup.

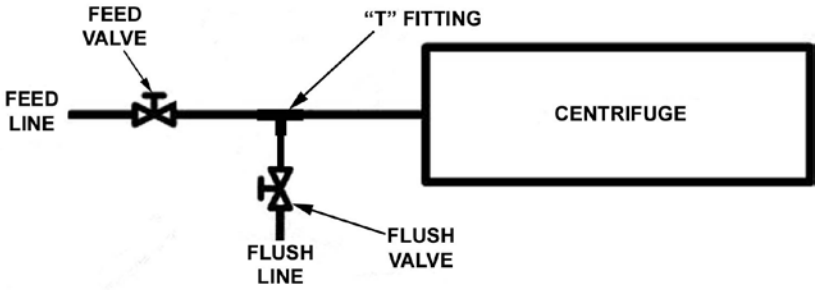


Figure 3-5. Feed and Flush Connections

COMPRESSED AIR

The centrifuge requires a source of clean, preferably instrument quality, filtered, dry compressed air or nitrogen at 60 to 115 PSI at 16SCFM for operation of the control cabinet purge system. The supply line must have a minimum diameter of 3/4" (20mm). The supply must be clean, non-flammable, and from a non-hazardous area. The cleanliness requirements are as follows:

Solid particles - 0.5μm <particle size ≤1μm, max. 1000 particles/m^3

Humidity - -40°C* pressure dewpoint

Oil content - ≤0.01mg/m^3 concentration total oil

* For applications where ambient temperature, Tamb ≤0°C, the air supply should be Class 2.1.1 with humidity -70°C pressure dewpoint

FEED PUMP

The customer is required to supply a feed pump for delivering slurry to the centrifuge. The recommended pump is a progressing cavity type having a fixed ratio gearbox and 15 HP maximum inverter-duty pump drive motor. The motor must be capable of operating in the 180 to 2700 RPM, 6 to 90 Hz speed range and also meet all other application requirements including voltage, frequency, and area of classification. The pump size, motor, and gearbox ratio must be

chosen to deliver the maximum desired flow at a pump rotor speed (determined by the manufacturer) to be low enough to prevent accelerated wear of the rotor and/or stator.

The pump must be connected to the centrifuge's control system as described under *Electric Power Connections* in this section, so that its operation can be supervised by the centrifuge.

ELECTRIC POWER CONNECTIONS

	DANGER! HIGH VOLTAGE! SHUT DOWN, LOCK OUT, AND TAG OUT ELECTRIC POWER, AND ENSURE THAT EQUIPMENT HAS STOPPED ROTATING BEFORE WORKING ON THIS EQUIPMENT.
	WARNING! CENTRIFUGE MUST BE OPERATED AT THE DESIGNATED SUPPLY VOLTAGE.
	WARNING! ELECTRICAL CONNECTIONS MUST BE MADE IN ACCORDANCE WITH ALL APPLICABLE NATIONAL AND LOCAL CODES. FAILURE TO COMPLY MAY RESULT IN AN UNSAFE CONDITION THAT COULD INJURE PERSONNEL OR DAMAGE EQUIPMENT. ENSURE THAT ALL ELECTRICAL AND CONDUIT CONNECTIONS ARE SECURE.

The centrifuge drive motors require three-phase line power and ground connections. In addition, the customer's feed pump motor must be connected to the centrifuge control system. For explosion-proof configurations, connect the facility's three-phase electric power supply to the contactor in the electrical panel (Figure 3-6 or 3-7). For non-explosion-proof machines, power connections are made inside control cabinet as shown.

Connect the feed pump motor to the terminal block in the bottom left side of the control cabinet as shown. The control system can operate a 12.5kW feed pump drive motor.

The **bowl and conveyor drive motors are not dual wound** and must be operated at the design voltage. For motor characteristics as well as additional information on electrical connections, refer to the electrical schematic diagram in Section 8.

A fused disconnect primary power supply is required for this equipment. The fused disconnect and interconnecting wiring to the equipment must be suitably sized and in accordance with National Electrical Code (NEC) standards and all other applicable state and local codes. Additional wiring requirements are as follows:

1. The fused disconnect device shall have sufficient interrupting capacity to clear the maximum fault current capability of the power supply system.
2. The GND connections in the electrical panel and control cabinet must be connected to a known ground.

ELECTRIC POWER CONNECTIONS (CONT'D)

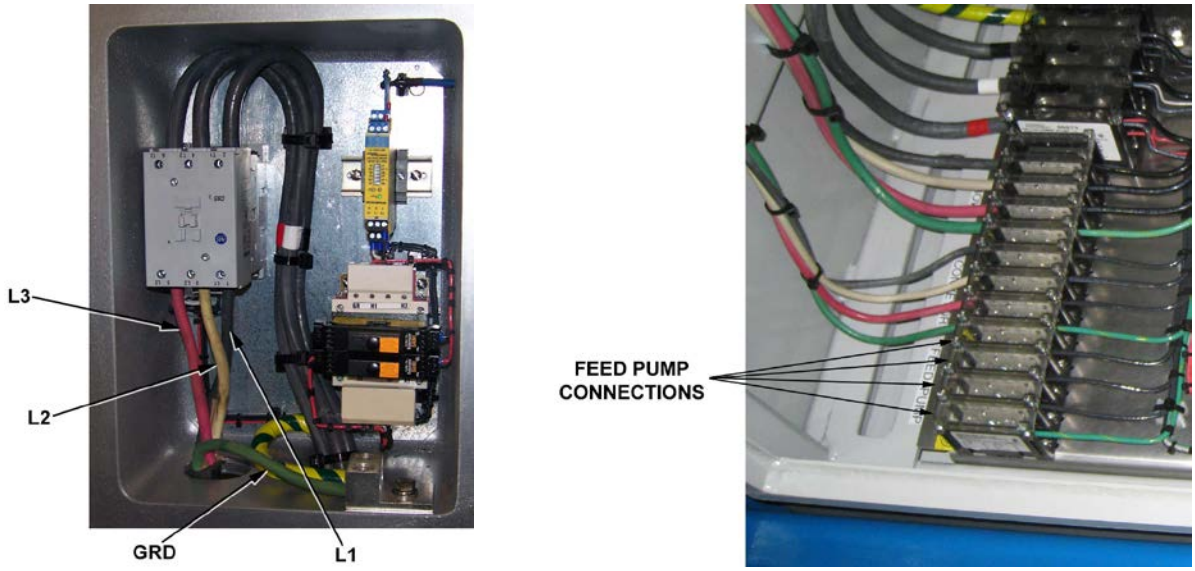


Figure 3-6. Explosion-Proof Centrifuge Input Power and Feed Pump Connections

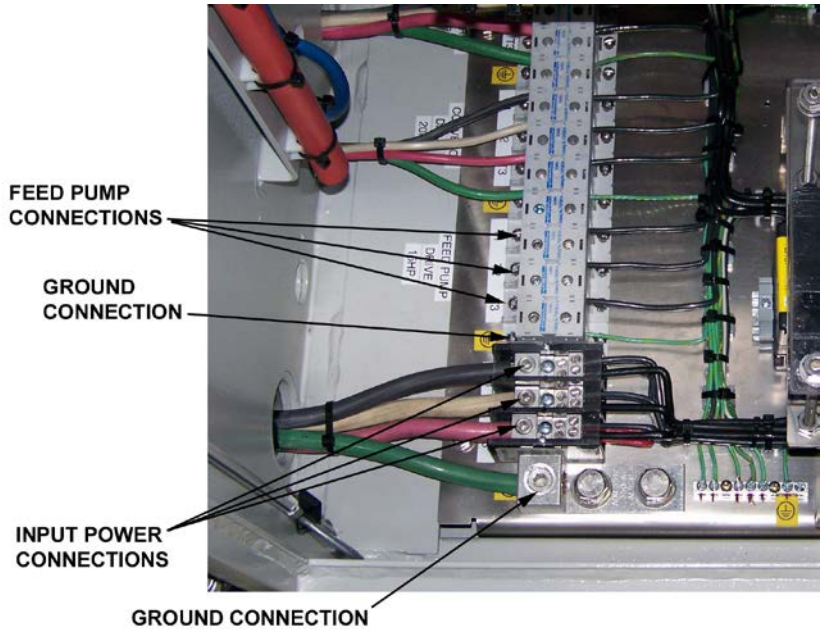


Figure 3-7. Non Explosion-Proof Centrifuge Input Power and Feed Pump Connections

POLARITY TEST

WARNING! BE CERTAIN THAT MOTORS ROTATE IN CORRECT DIRECTION. INCORRECT POLARITY OF CONVEYOR MOTOR WILL CAUSE CONVEYOR TO ROTATE AT AN INCORRECT SPEED, WHICH WILL RESULT IN PROCESSING PROBLEMS.

In the following procedure, polarity is critical. Be certain that all motors rotate in the correct directions. Simply checking to see if solids are discharged out the solid end **DOES NOT** ensure correct polarity!

If conveyor motor is wired incorrectly, the conveyor may become plugged or flooded depending on the speed settings of the bowl and conveyor. Test for correct polarity of all connections as follows:

1. Apply power to centrifuge.
2. Confirm direction of rotation for air conditioner condenser and evaporator motors by selecting *Test AC* on Centrifuge Status screen (refer to Section 4) to turn on motors. Rotation is to be as follows:
   a. Condenser motor - **Clockwise viewed from fan end**
   b. Evaporator motor - **Clockwise viewed from inside cabinet**
3. Correct reverse rotation of air conditioner motors by shutting down power and switching any two of the three power leads at the motor or terminal strip (refer to Figure 3-6 and electrical schematic diagram in Section 8).

WARNING! EQUIPMENT WILL BE DAMAGED IF AIR CONDITIONER EVAPORATOR AND/OR CONDENSER MOTOR ROTATES IN OPPOSITE DIRECTION. CORRECT ROTATION BEFORE OPERATING MACHINE.

4. Run bowl at 20 RPM with a conveyor differential speed of 5 RPM.
5. Confirm direction of rotation for bowl, conveyor, and feed pump motors as follows:
   a. Bowl - Counterclockwise viewed from fan end
   b. Conveyor - Clockwise viewed from fan end
   c. Feed pump - Per manufacturer's data
6. Correct reverse rotation of bowl or conveyor motor by shutting down power and switching any two of the three power leads at the motor or terminal strip (refer to Figure 3-6 and electrical schematic diagram in Section 8). If feed pump rotation is incorrect, refer to manufacturer's data for information to reverse rotation.

MACHINE STARTUP

Refer to Section 4 for initial startup and operating procedures for the centrifuge.

WARNING! DO NOT ATTEMPT TO OPERATE MACHINE WITH SHIPPING COMPONENTS INSTALLED.

SECTION 4 - OPERATING INSTRUCTIONS

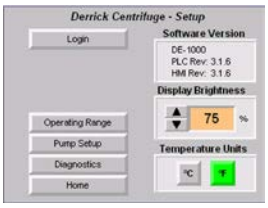
GENERAL

The procedures in this section are for use only by trained personnel who are qualified to operate high-speed rotating equipment. Initial and normal startup, operation, shutdown, and emergency shutdown procedures are included. Following the startup and operation procedures, detailed information on the control screens is provided to assist the operator and technician in understanding centrifuge operation and fully utilizing its capabilities.

The centrifuge is designed to be operated only for the purpose specified at the time of purchase. Operation in any other application requires consultation with Derrick engineering.

SOFTWARE VERSION

The operating procedures in this section apply to DE-1000LP VFD centrifuges having software Version 3.1.6 installed. The software version is shown on the Setup screen shown below:



Although operating procedures are generally identical, an earlier software version may cause some screens to appear slightly different from those shown on the following pages.

OPERATING SAFETY

⚠	**WARNING! ALL OPERATING AND MAINTENANCE PERSONNEL MUST READ AND UNDERSTAND ALL SAFETY INFORMATION IN THIS MANUAL BEFORE WORKING WITH THE EQUIPMENT.**
⚠	**WARNING! BE SURE THAT COVER IS CLOSED AND SECURED AND ALL PERSONNEL ARE CLEAR BEFORE STARTING MACHINE.**
⚠	**WARNING! BE SURE THAT ALL SHIPPING COMPONENTS HAVE BEEN REMOVED AND BEARING PILLOW BLOCKS ARE PROPERLY TIGHTENED.**
⚠	**WARNING! ALWAYS ALLOW MACHINE TO COAST TO A COMPLETE STOP BEFORE OPENING COVER OR REMOVING GUARDS.**
⚠	**WARNING! DO NOT OPERATE CENTRIFUGE IF EXCESSIVE NOISE OR VIBRATION DEVELOPS. ALWAYS CONFIRM THAT VIBRATION SWITCH AND OTHER SAFETY DEVICES ARE FUNCTIONAL.**

WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO OPERATORS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

TOP COVER OPENING/CLOSING PROCEDURES

The proper procedures for opening and closing the top cover of the centrifuge must always be followed. Two operators using both hands are required to open the cover. Derrick recommends having a hoist available if additional assistance is desired during the opening/closing of the centrifuge cover. To open and close the cover, proceed as follows:

1. Shut down, lock out, tag out electric power to centrifuge, and allow rotating assembly to coast to a full stop.
2. Remove bolts securing cover to base.
3. Have two operators using both hands grip the cover handles securely to ensure full control of the cover throughout the opening and closing process.
4. As the cover is raised, ensure that body limbs of all personnel and any other items remain clear of the cover gap at all times.
5. Raise the cover to the fully opened position, and insert a 1/2” (12.7mm) hardened steel pin through one hinge to lock the cover open.
6. After performing the activity that required the cover to be opened, reverse steps 2 through 5 to close the cover. During the closing procedure, ensure that both operators are capable of controlling the cover’s descent and that all body limbs and other items remain clear of the gap.

COLD CLIMATE STARTUP

In below-freezing ambient conditions where steam, portable heaters, or other means is used to raise the temperature of the centrifuge, re-lubrication of bearings may be necessary prior to startup. If bearing housings reach a temperature of 200°F (93°C), grease may liquefy and drain from bearings. This will result in dry running the bearings upon startup. To prevent this condition, proceed as follows:

1. After applying heat and prior to startup, pump 15 shots of grease into each main bearing.
2. Refill conveyor bearings until grease is observed exiting the appropriate drain hole.
3. After machine is started, pump an additional five shots of grease into each main bearing.
4. Monitor bearing temperatures for the first 2 hours of centrifuge operation.

Note! It is normal for temperatures to rise for 15 to 30 minutes after greasing and then return to normal.

PURGE SYSTEM (HAZARDOUS ENVIRONMENT ONLY)

Purge Cycle

During startup, the control cabinet purge system drives out all gases from the cabinet interior and then maintains positive pressure within the control cabinet to prevent entry of any potentially explosive gases. Purge system operation begins when the system senses sufficient air pressure

inside the cabinet. Initially, the purge unit performs a 16-minute rapid purge cycle at 16 CFM. During the rapid purge cycle, the purge system prevents application of electric power to the cabinet. At the end of the rapid purge cycle, the purge system closes the main electrical contactor, allowing electric power to flow to the cabinet. The centrifuge may then be started.

After the rapid purge cycle, the purge system maintains positive pressure within the cabinet to prevent entry of hazardous gases, automatically compensating for pressure loss due to cabinet leakage. If at any time a loss of cabinet pressure is detected, the main contactor opens immediately, disconnecting power. If a shutdown occurs during centrifuge operation, the purge system performs another 16-minute rapid purge before power is restored to the cabinet.

Purge System Bypass

WARNING! DO NOT BYPASS PURGE SYSTEM IF NOT CERTAIN THAT ENVIRONMENT IS NON-HAZARDOUS. A HIGH RISK OF FIRE AND/OR EXPLOSION WILL RESULT IF PURGE SYSTEM IS BYPASSED IN A HAZARDOUS AREA.

If the centrifuge is located in a non-hazardous environment, the purge system may be turned off. **A high risk of fire and/or explosion will result if purge system is bypassed in a hazardous area.** Also, with the purge system bypassed, the centrifuge will remain energized if the control cabinet door is opened. **Consequently, use extreme caution when operating the equipment or performing any procedure with purge system bypassed**. If the centrifuge is moved to a hazardous environment, the bypass must be removed and satisfactory purge system operation confirmed.

DANGER! USE EXTREME CAUTION WHEN OPERATING CENTRIFUGE WITH PURGE SYSTEM BYPASSED. DANGEROUSLY HIGH VOLTAGE WILL BE PRESENT IN CONTROL CABINET IF DOOR IS OPENED WHILE POWER IS APPLIED.

To bypass the purge system, proceed as follows:

1. Be certain that centrifuge is in a non-hazardous environment; then shut down, lock out, and tag out electric power to centrifuge.
2. Remove bolts securing electrical panel door, and open door.
3. Locate intrinsic barrier at upper right side of electrical panel, and install a jumper across terminals 1 and 4 to disable the purge system (Figure 4-1).
4. Label jumper **“Purge Bypass”**.
5. To restore purge system operation, remove the **“Purge Bypass”** jumper, and close and secure electrical panel door. Confirm proper operation of the purge system.

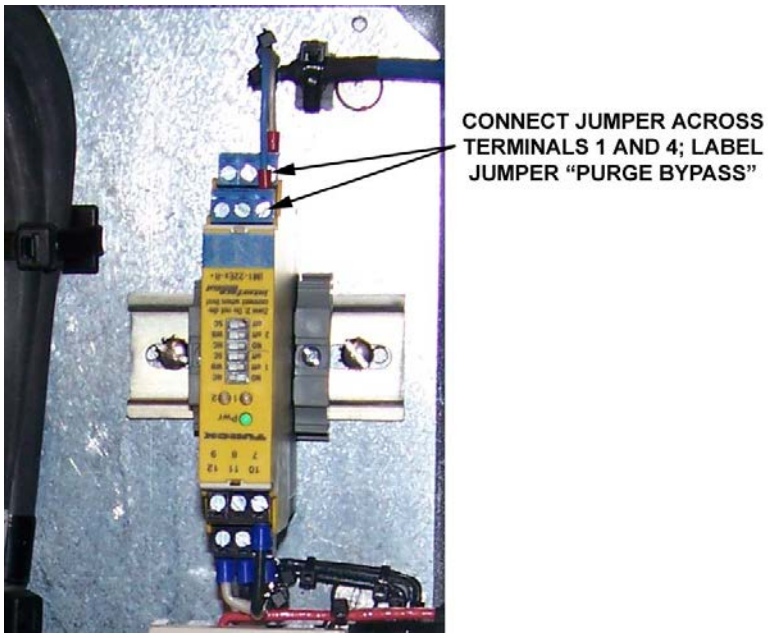


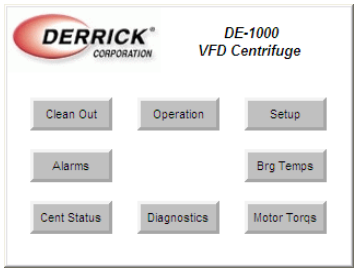
Figure 4-1. Purge System Bypass

INITIAL STARTUP

Note! If rotating assembly is heated, before starting centrifuge follow COLD CLIMATE STARTUP instructions later in this section to ensure proper bearing lubrication.

Perform the initial startup procedure when the centrifuge is being started for the first time following installation or after the machine has been relocated.

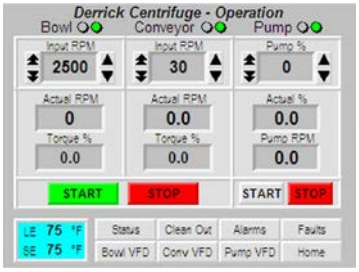
1. Check that all tools, documents, and shipping components have been removed, and there are no obstructions to operation.
2. Verify that all personnel are clear of equipment.
3. Confirm that all operators and maintenance personnel have read and understand all operating and safety information in Section 2.
4. Verify that equipment has been installed properly, all shipping brackets have been removed, and bearing pillow blocks have been tightened to specified torque per Section 5.
5. For explosion-proof cabinet, turn on compressed air to purge system.
6. Apply electric power to centrifuge. The following screen will appear (on explosion-proof cabinet, displayed after purge cycle is completed):



7. Without the centrifuge running, perform the following safety checks to confirm that connections are correct between control cabinet and centrifuge:
   - Operate emergency stop button, and check for Emergency Stop alarm message on control panel.
   - Pull out emergency stop button to clear alarm message.
   - Tap vibration switch housing horizontally with a rubber or rawhide mallet, and check for High Vibration Fault message on control panel.
   - Press reset button on vibration switch to clear alarm message.
8. Select *Cent. Status* to verify that machine is ready for operation. Correct any deficiencies before proceeding with startup procedure. If condition is satisfactory, click in the upper right corner to return to the *Home* screen.
9. Select *Setup* and then click on *Pump Setup* to view pump operating information. Revise any operating information, if required, and then click in upper right corner to return to *Setup* screen. Select Home to return to *Home* screen.
10. Configure pump parameters as follows:
    a. Input data from the pump and pump motor nameplates.

Note! Correct pump data is critical to achieving the desired feed rate to the centrifuge.

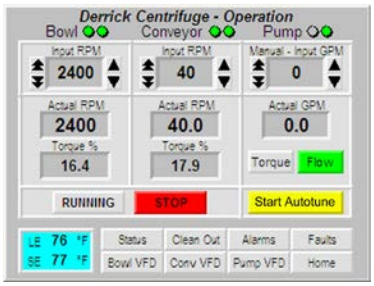
    b. Select *Download* to update VFD settings with new motor data. This will cause pump to autotune at the next startup.
    c. Select *Disable* for Tank High and Low Level inputs, if they will not be used.
    d. When finished making required changes, click “X” in upper right corner to return to Setup screen; then select *Home* to return to Home screen.
11. Select *Operation* to display the following screen:



12. Using up and down arrow buttons, set Bowl Input RPM at 20 RPM, and set Conveyor Input RPM at 5 RPM.
13. Select *START* to confirm direction of rotation for bowl, conveyor, feed pump, and air conditioner condenser motors as follows:
    - Bowl - Counterclockwise viewed from fan end
    - Conveyor - Clockwise viewed from fan end
    - Feed pump - Per manufacturer’s data
    - Air conditioner condenser - Clockwise viewed from fan end
14. Correct reverse rotation by shutting down power and switching any two of the three power leads at the terminal block(s) inside the cabinet (refer to Section 2 and electrical schematic diagram in Section 8.

INITIAL STARTUP (CONT'D)

15. After confirming correct motor rotational directions, enter desired Bowl Speed of at least 750RPM, and enter desired Differential Speed; select *START* to begin centrifuge operation. Screen will display actual Bowl Speed, Differential Speed, and Torque %. When bowl speed reaches 750RPM, START/STOP at right side of screen will change to *Autotune.*



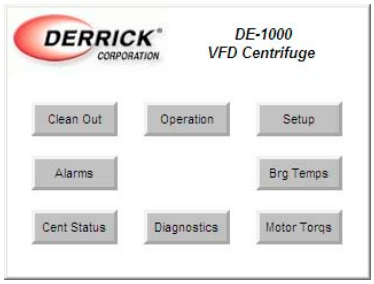
16. Select *Autotune* to tune pump drive motor to VFD. Allow about 60 seconds for autotuning.

17. Start centrifuge in accordance with Normal Startup procedure below, beginning with step 4.

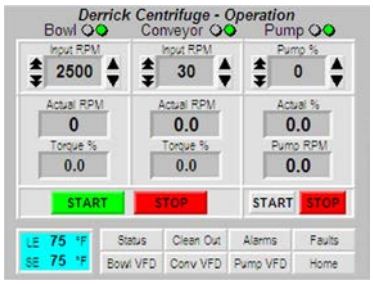
NORMAL STARTUP

Note! If Centrifuge is Heated, Before Starting Centrifuge Follow COLD CLIMATE STARTUP Instructions to Ensure Proper Bearing Lubrication.

1. Without electric power applied, open cover and rotate bowl assembly manually to check that the bowl turns freely and no rubbing is felt.
2. Close cover, tighten all cover bolts to required torque (refer to Section 5), and ensure that all guards are in place.
3. Verify that all personnel are clear of centrifuge and all guards are in place before applying electric power to equipment.
4. Apply electric power to centrifuge. The following screen will appear after purge cycle is completed:



5. With Home screen displayed, select *Operation* to display the following screen:



6. Using up and down arrows, set Bowl and Conveyor Input RPMs at desired speeds (750RPM minimum).
7. Select *START* to turn on centrifuge. Note that Bowl and Conveyor speeds will gradually rise until settings are reached, and Torque % for bowl and conveyor will rise. If pump drive motor data has been changed since previous startup, select *Autotune* to tune motor to VFD.
8. When bowl speed has reached speed setting, select *Pump START* to start feed pump, and slowly introduce feed to centrifuge.

Note! Pump will not start until actual bowl speed is within 120RPM of setting.

9. Adjust feed rate, Bowl speed, and/or Conveyor speed as required to optimize centrifuge operation. Select *Data* screens at any time to review and monitor centrifuge operating characteristics, including air conditioner status, elapsed operating time, and VFD data.

Note! Depending on conveyor differential speed setting, at bowl speeds above 300RPM conveyor motor may rotate in opposite direction.

OPERATION

The properties of the inlet slurry and desired separation should be known in advance. This information can be used to set and change bowl speed, conveyor differential speed, and feed rate (unless set for automatic control) as required during centrifuge operation. Continual monitoring of the centrifuge control panel indications, as well as the condition of the inlet slurry, are essential to achieving desired effluent clarity and solids dryness. Rising conveyor torque indicates that one or more operating parameters should be lowered to reduce torque. Conversely, falling conveyor torque shows that speed can be raised and/or feed rate increased. Operating parameters should be adjusted, as required, to optimize centrifuge operation and prevent automatic shutdown due to excessive bowl or conveyor torque.

The Operation screen (Figures 4-2 and 4-3) permit the operator to view current operating information for the bowl, conveyor, and pump and adjust the parameters as required to meet changing conditions. Through this screen, the operator may view and set bowl and conveyor RPMs and torque percentages, set feed pump flow rate, and view bearing temperatures. Adjustments of the conveyor and bowl speeds may be performed using up and down arrows or by entering actual numbers on the numeric keypad. In addition, options are provided for stopping the centrifuge, displaying VFD operation screens, and selecting Status, Clean Out, Faults, Alarms, and Home screens. The following parameters affect centrifuge operation: Feed rate, pond depth, bowl speed, and conveyor speed.

Adjustment of one parameter may produce the desired clarity of liquid effluent and solids dryness. Or the desired performance may be achieved by further adjustment. It is important to understand the interdependence of the operating parameters. Changing one characteristic results in other effects that may warrant additional adjustments.

Except for pond depth, these parameters can be adjusted while the centrifuge is operating. The operator may then view the results of one change before making additional adjustments. The following paragraphs describe the effect of changing each parameter.

OPERATION (CONT'D)

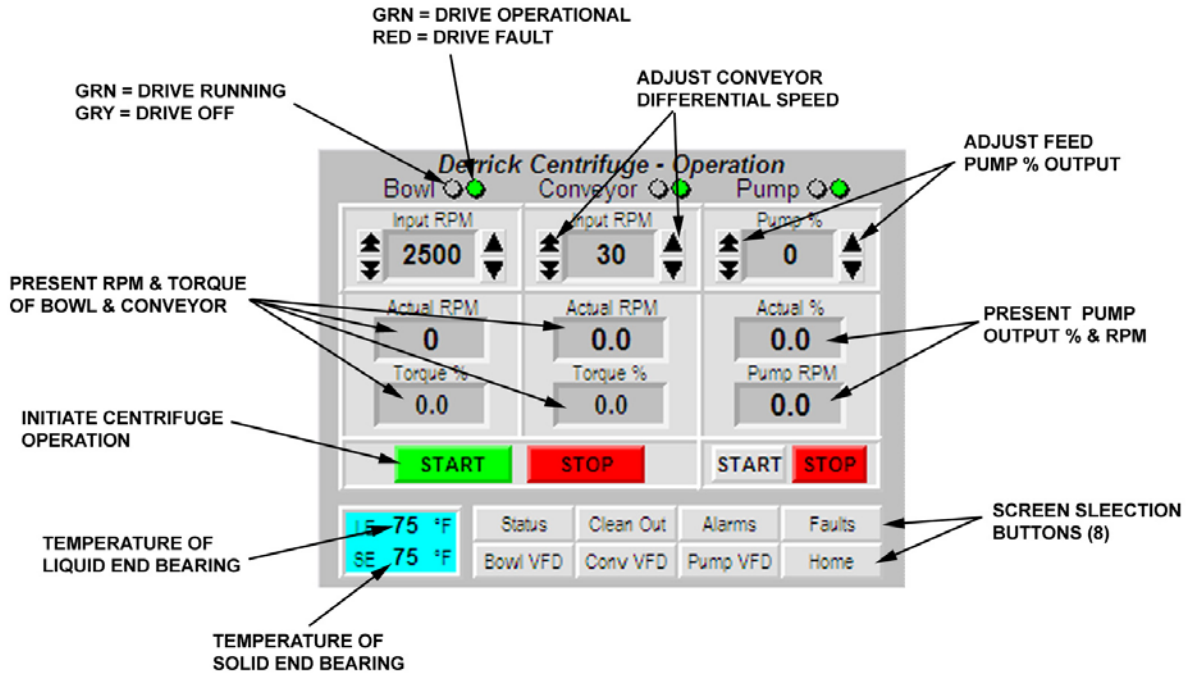


Figure 4-2. Operation Screen At Startup

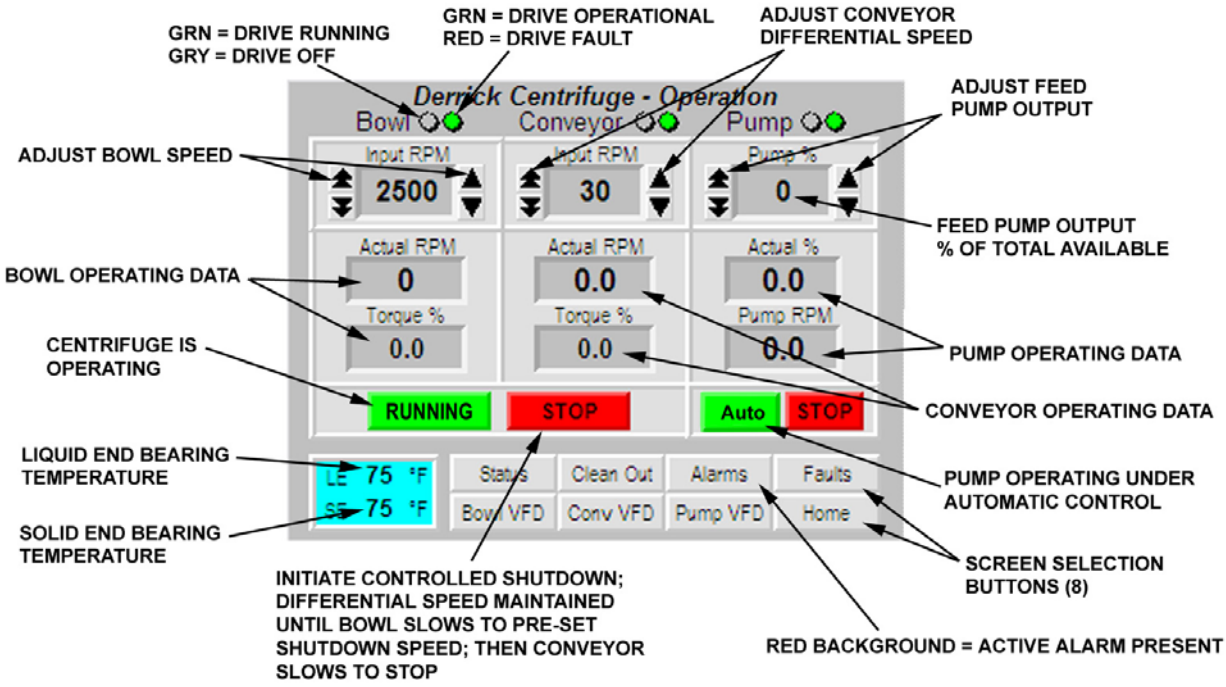


Figure 4-3. Operation Screen While Running

Feed Rate

When *Manual* is selected on the Operation screen, the operator manually enters the desired rate on the Operation screen. If the slurry is low in viscosity and density, increasing the feed rate may permit a higher processing rate. However, as feed rate is increased, residence time in the bowl is decreased, resulting in more solids in the liquid discharge. Also, conveyor torque may rise indicating that the conveyor is becoming burdened by moving the increased solids volume at its present speed. To reduce the conveyor torque, the bowl speed may be lowered, the feed rate may be reduced, or the conveyor speed may be increased to move the solids out faster. The feed rate setting and actual feed rate are shown on the control panel to assist the operator in making adjustments.

Bowl Speed

The faster the bowl speed, the faster solids are settled through the pond to the outer wall of the bowl and conveyed out of the centrifuge, but faster processing results in wetter solids discharge. To reduce wetness, the slurry must remain in the bowl longer, subjecting it to the settling process for a longer duration before being conveyed out the solids discharge. Conversely, reducing bowl speed may be desirable for thick, heavy slurry to extract only high-density materials or larger particles.

Both the bowl speed setting and actual bowl speed are shown on the control panel. The torque percentage of the bowl is also displayed. This information is useful in optimizing bowl speed to produce the desired solids dryness and processing speed.

Conveyor Differential Speed

With correct wiring polarity, the conveyor responds properly to settings made on the Operation screen. Changing the conveyor differential speed adjusts the solids discharge rate. Generally, a slower differential speed will produce drier solids but reduces the solids discharge rate. Increasing conveyor speed reduces drying time, leading to wetter discharged solids. Reducing conveyor speed results in drier solids discharge. However, excessively slow conveyor speed permits solids to accumulate in the bowl, possibly causing an overload condition.

The drying time is reduced by increasing the conveyor differential speed, which will increase the wetness of the solids. Reducing the conveyor differential speed raises the settling time, which will produce drier solids.

Both the conveyor speed setting and actual conveyor speed are shown on the control panel. In addition, the conveyor torque percentage is shown to assist in optimizing conveyor speed to produce the desired solids dryness and processing speed.

Since the conveyor differential speed is controlled by the PLC relative to the bowl speed setting, wiring polarity of electrical components is critical. Electrical polarity determines the actual speed and direction of conveyor motor for any bowl speed setting. For example, with a bowl speed setting of 2000 RPM and conveyor differential speed set at 60, the conveyor motor will rotate in reverse at -1120 RPM.

The correct bowl-conveyor speed relationship depends on correct wiring polarity. If polarity is reversed, the same bowl speed setting of 2000 RPM described above would result in an actual conveyor differential speed of about 17 rather than the setting of 60.

Pond Depth

Four adjustable effluent ports (Figure 4-4) are provided on the liquid bowl head to facilitate setting the pond depth; all ports must be set identically. A higher pond depth increases settling time by permitting more liquid to remain in the bowl. However, a higher pond depth also reduces the beach area at the solids discharge end of the bowl, which will result in a wetter solids discharge.

Pond depth can only be adjusted with the centrifuge fully stopped and disabled. For this reason, pond depth is usually adjusted last. The factory pond depth setting is usually satisfactory when used in conjunction with feed rate, bowl speed, and conveyor speed adjustments. However, if desired results cannot be achieved by other means, the pond depth may require re-setting.

To adjust pond depth, proceed as follows:

WARNING! DO NOT OPEN COVER OR ATTEMPT ANY ADJUSTMENT OR MAINTENANCE ON THE CENTRIFUGE UNLESS THE BOWL IS AT A COMPLETE STANDSTILL.

WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO OPERATORS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

1. Shut down, lock out, and tag out the centrifuge using the Normal Shutdown procedure described later in this section.
2. Open case cover.
3. Loosen three screws securing mounting ring to liquid bowl head, rotate the effluent port until the desired setting is positioned at the alignment marks, and tighten screws. All four effluent ports must be set to the same position.
4. Close case cover after completing adjustments.

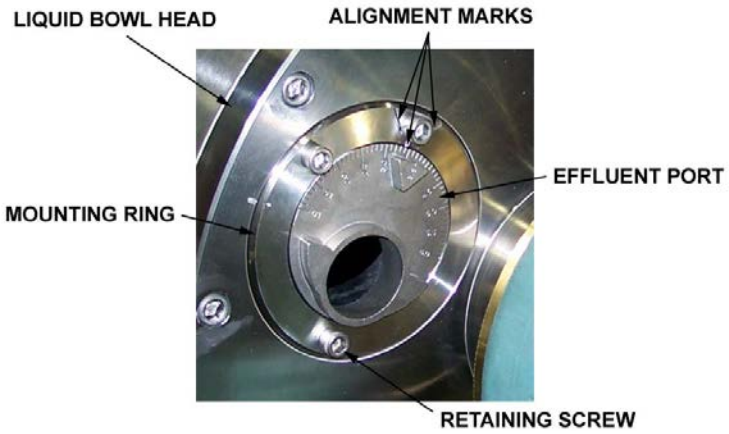


Figure 4-4. Effluent Port Adjustment

Differential Speed/Conveyor Torque

Generally, a faster conveyor speed results in lower conveyor torque, as solids are discharged faster and usually wetter. Reducing conveyor speed must be done slowly and cautiously, allowing steady-state to be reached before further reduction. Slower conveyor speeds permit solids to remain in the bowl longer. This can permit solids to accumulate in the bowl if the input rate exceeds the discharge rate. Therefore, the torque must be monitored to prevent overload.

Torque limit settings control automatic feed reduction and centrifuge shutdown. As conveyor torque rises, the feed rate is gradually reduced. If torque continues to rise, the feed rate is more rapidly reduced. Upon reaching the maximum conveyor torque setting, the centrifuge is shut down.

At certain conveyor speeds the drive motor must reverse direction to accommodate the differential speed relationship with the bowl. If this occurs, the centrifuge control system automatically assumes control of the feed pump to reduce its flow rate. The message “Automatic Flowrate” appears on the Operation screen to alert personnel that the feed pump is under automatic control. When the reduced feed rate is reached, a 20-second timer is started. Upon expiration of the timed interval, a new conveyor differential speed is applied to correspond with the revised flow rate. The pump feed rate returns to the previous rate when the new differential speed is reached. Manual control of the feed pump is then restored. This action releases the feed pump from automatic control and clears the Automatic Flowrate message from the screen.

ALARM AND FAULT MESSAGES

During centrifuge operation, a message may appear to alert the operator to an anomaly that requires operator intervention. Alarm messages signify that the prevailing condition must be corrected or the centrifuge may be shut down automatically. Fault messages inform the operator that a failure requiring automatic shutdown has occurred. Refer to Section 5 for alarm messages and their causes and corrective actions.

BEARING TEMPERATURES

Bearing temperature trends may be viewed in graphical form on the Bearing Temperature screen (Figure 4-5). Temperatures are updated in accordance with a pre-set interval, and scroll buttons are provided to facilitate examination of trends over time. Solid and liquid end temperatures are displayed at the right side of the screen. The Motor Torque screen is also accessible from the Bearing Temperature screen. The operator may return to the Operation or Home screen using the buttons at the lower right of the screen.

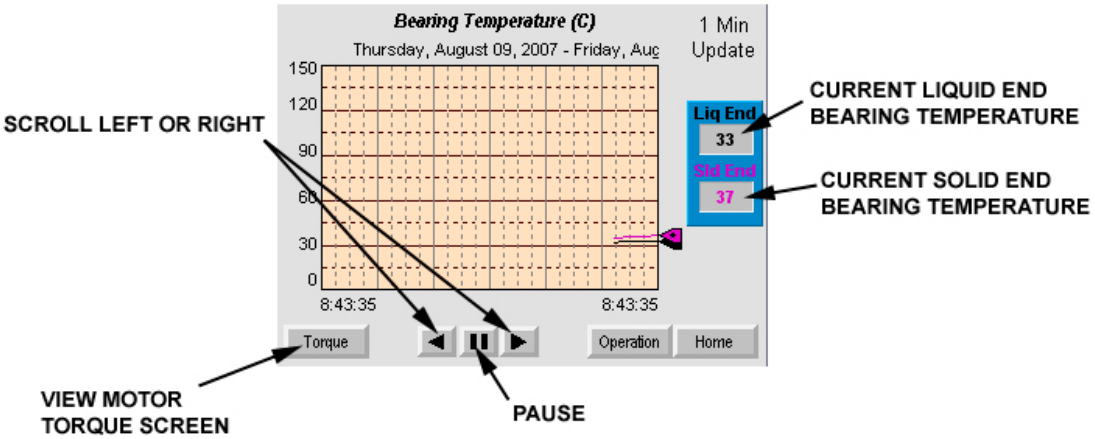


Figure 4-5. Bearing Temperature Screen

MOTOR TORQUE TREND

Bowl and conveyor torque trends may be viewed in graphical form on the Motor Torque trend screen (Figure 4-6). Torques are updated in accordance with a pre-set interval (one minute), and scroll buttons are provided to facilitate examination of trends over time. Bowl and conveyor torques are displayed at the right side of the screen. The Bearing Temperature screen is also accessible from the Motor Torque screen. The operator may return to the Operation or Home screen using the buttons at the lower right of the screen.

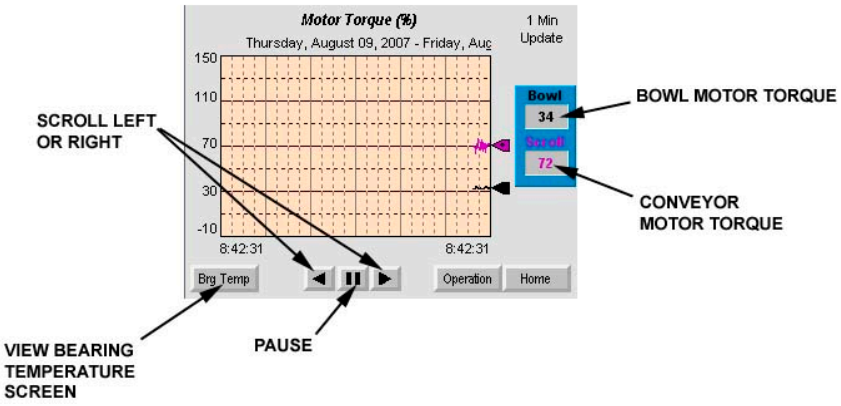


Figure 4-6. Motor Torque Trend Screen

SYSTEM DIAGNOSTICS

Built-in system diagnostics continually analyze the DE-1000LP control system for malfunctions. The Diagnostics screen (Figure 4-7) aids in troubleshooting by displaying any fault in the critical areas of the centrifuge. The current operational status of the Bowl, Conveyor, and Pump VFDs, as well as the speed and temperature sensors are displayed on this screen. Analog readings in mA are displayed at the bottom of the screen for main bearing temperature sensors and bowl speed sensor. The screen is accessible from the Home screen, as well as the three VFD screens.

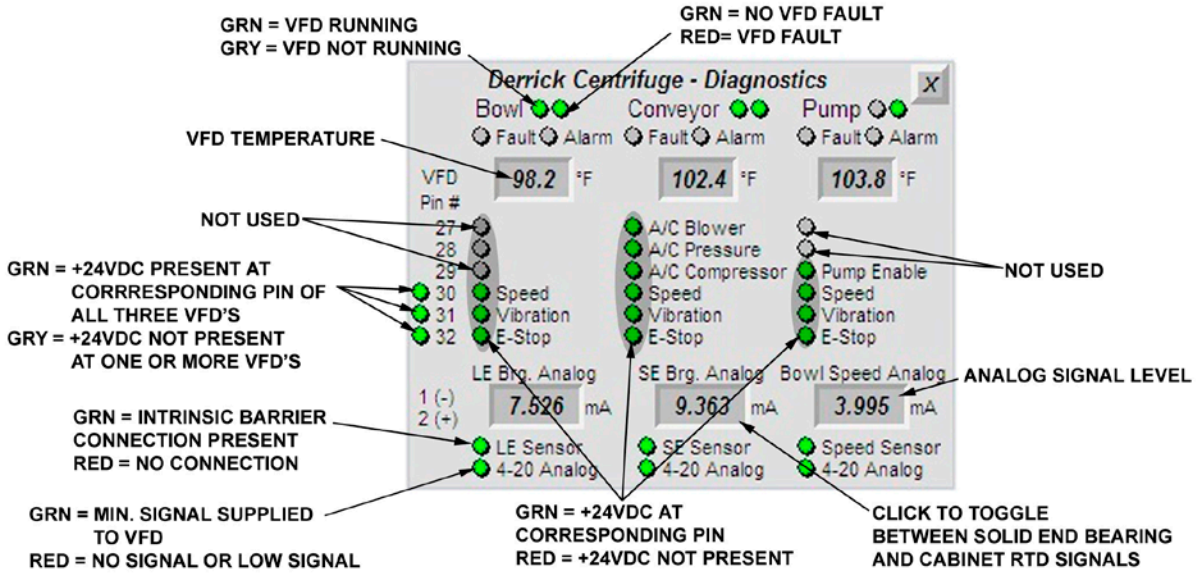
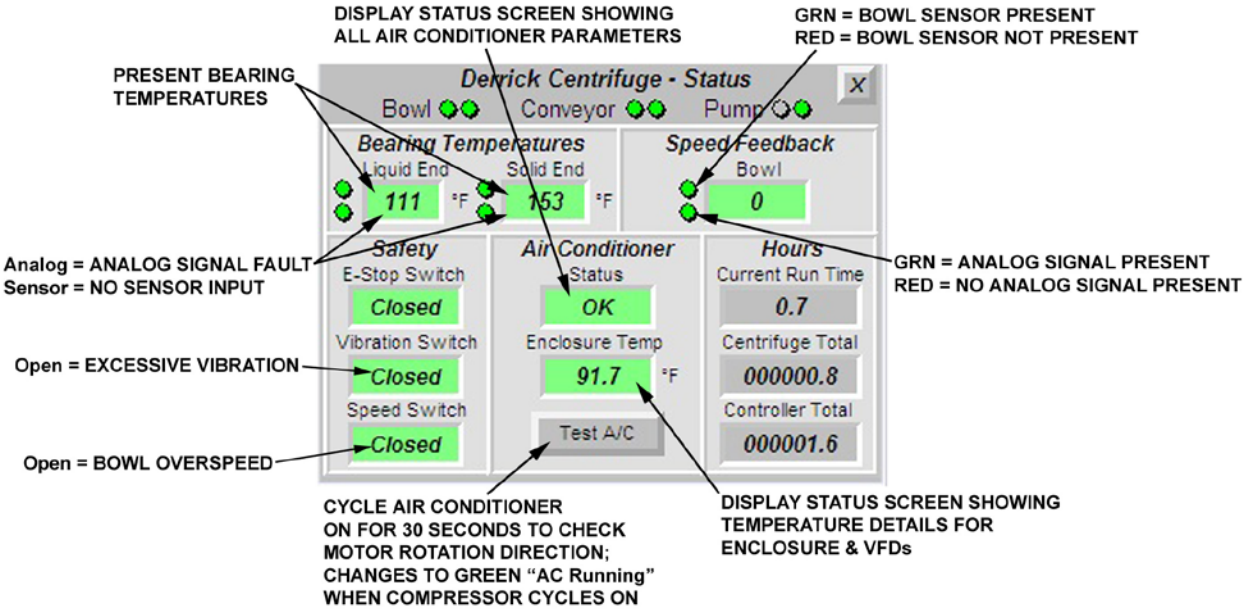


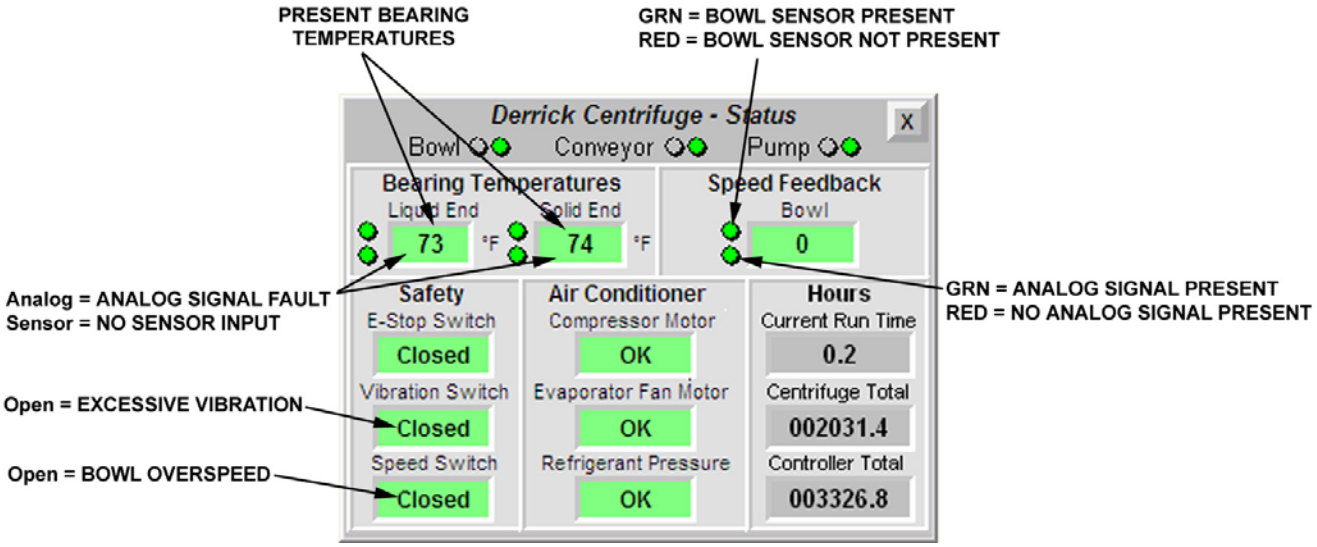
Figure 4-7. Diagnostics Screen

PERFORMANCE STATUS

Current performance information is shown on the Centrifuge Status screen (Figure 4-8). Cabinet enclosure temperature, as well as VFD temperatures and other status details are shown in Figure 4-9. Parameters displayed include bearing temperatures, bowl speed and sensor condition, status of safety devices (vibration switch, emergency stop, and bowl overspeed), air conditioner operation, and operating hours. Operating status of the air conditioner is also shown (note differences between screens for centrifuge with and without RTD sensor to detect cabinet interior temperature). Exiting this screen returns to the previous screen. Safety shutdowns are denoted by color change from green to red and display of a word explaining cause of shutdown.



Centrifuge With RTD Sensor



Centrifuge Without RTD Sensor

Figure 4-8. Centrifuge Status Screen

PERFORMANCE STATUS (CONT'D)

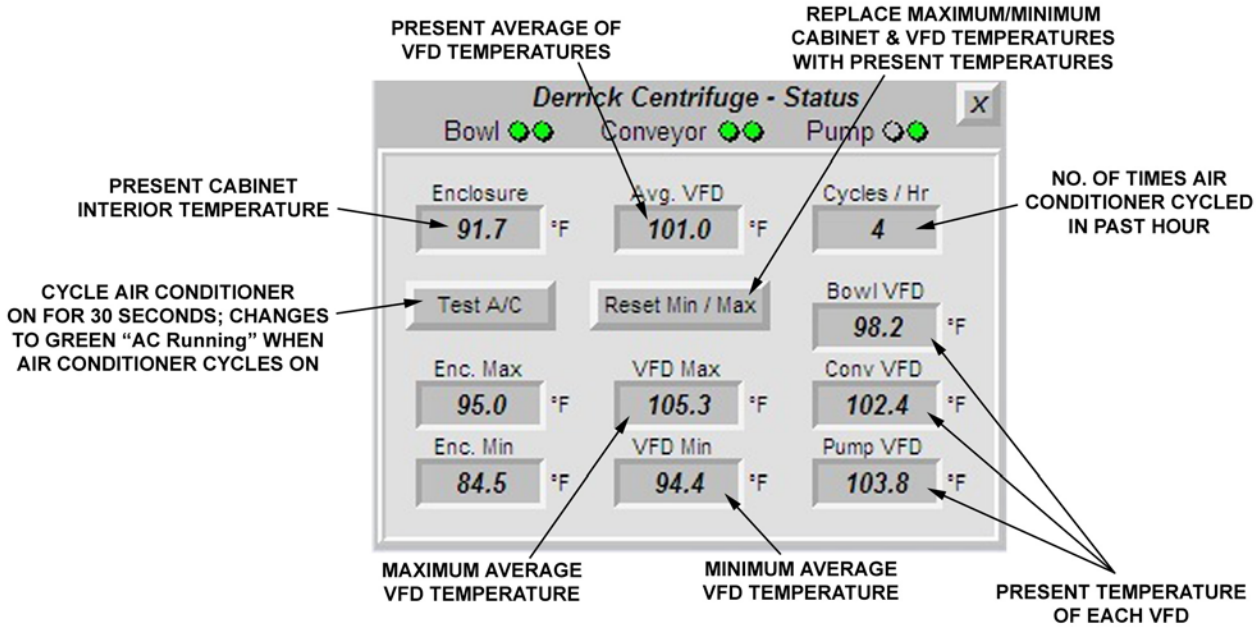


Figure 4-9. Cabinet and VFD Temperature Status Screen

ALARMS

The Alarms screen (Figure 4-10) permits the operator to review and acknowledge active alarm messages. Each alarm is listed with its status, date and time received, and description. Buttons are provided at the bottom of the screen to facilitate scrolling through the alarms. Messages may be acknowledged individually, or all alarms may be acknowledged simultaneously. Provisions are included for sorting alarms in the order of occurrence, and buttons are included for returning to the Operation or Home screen.

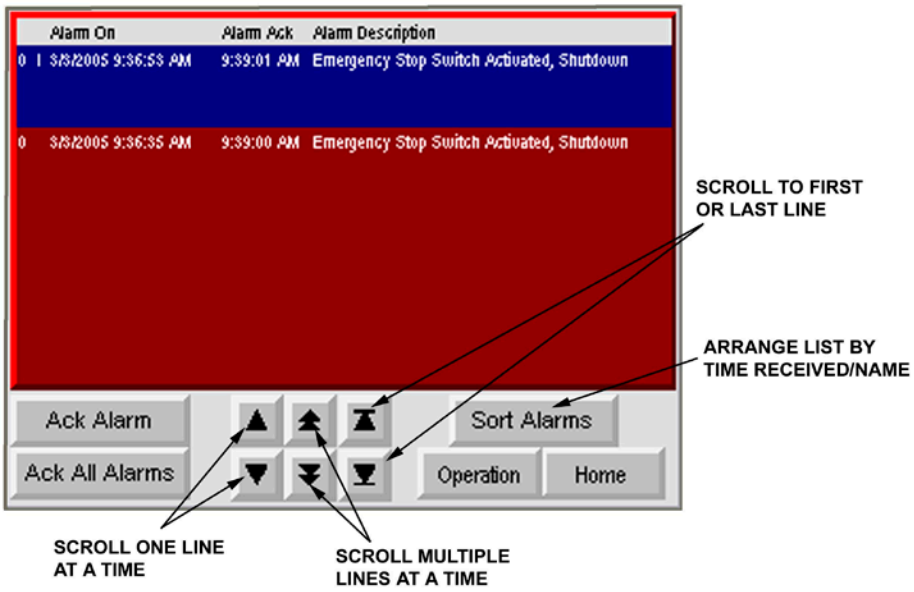

Alarm On
Alarm Ack
Alarm Description
0 I 3/3/2005 9:36:33 AM 9:39:01 AM Emergency Stop Switch Activated, Shutdown
0 3/3/2005 9:36:33 AM 9:39:00 AM Emergency Stop Switch Activated, Shutdown
SCROLL TO FIRST OR LAST LINE
ARRANGE LIST BY TIME RECEIVED/NAME
Ack Alarm
Ack All Alarms
Sort Alarms
Operation
Home
SCROLL ONE LINE AT A TIME
SCROLL MULTIPLE LINES AT A TIME

Figure 4-10. Alarms Screen

VFD STATUS

Status screens (Figure 4-11 through 4-13) are selected from the Operation screen. Each VFD status screen permits the operator to view various operational characteristics of the VFD such as present alarms or faults; power, voltage, and current outputs; motor and bowl speeds; direction of motor rotation; VFD temperature, and motor torque.

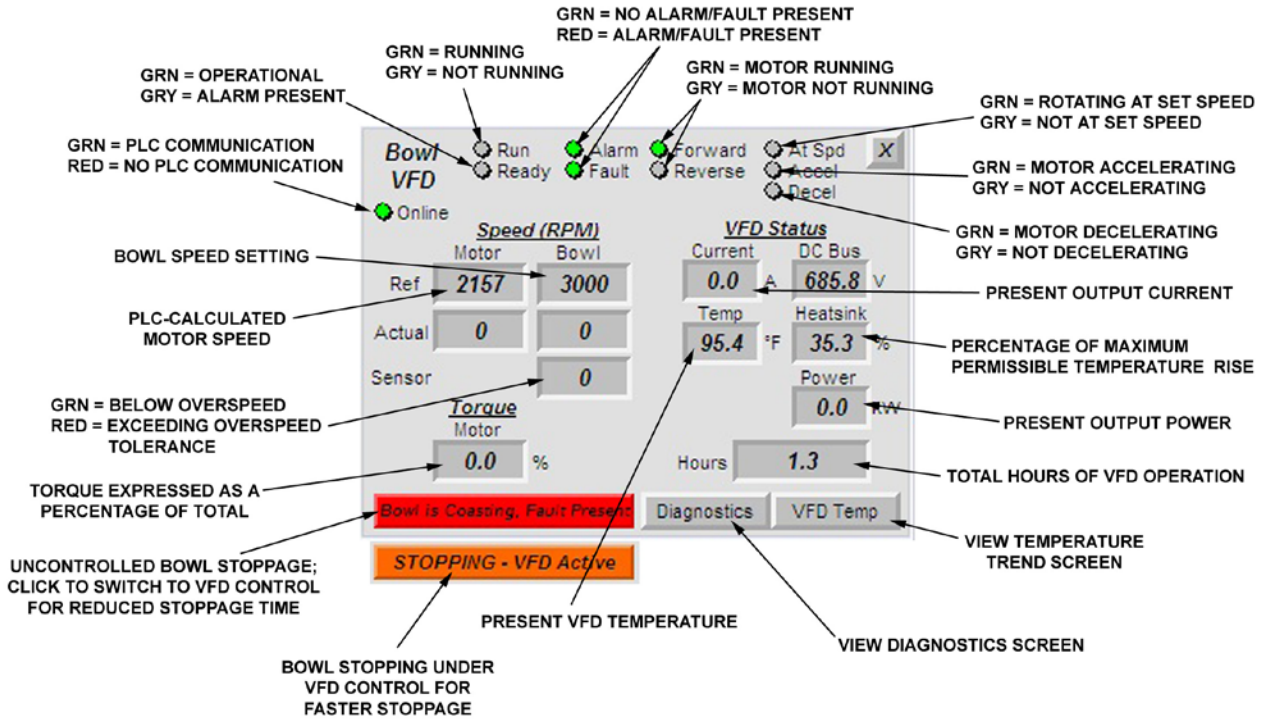


Figure 4-11. Bowl VFD Screen

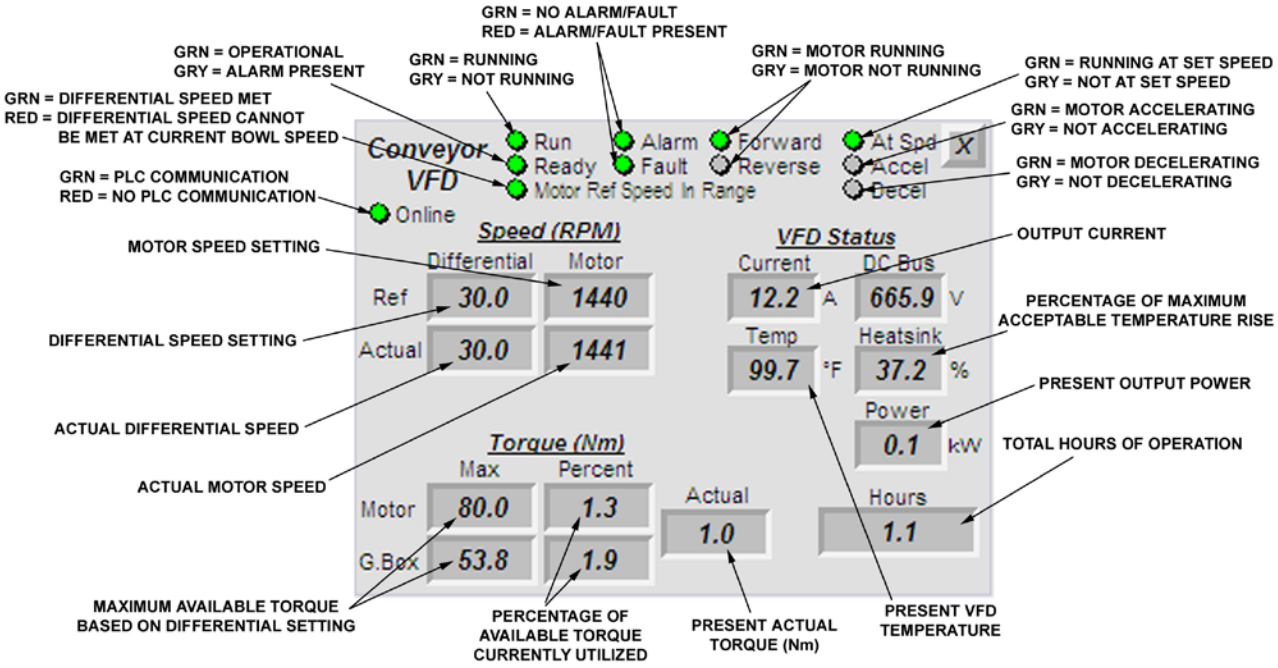


Figure 4-12. Conveyor VFD Screen

VFD STATUS (CONT'D)

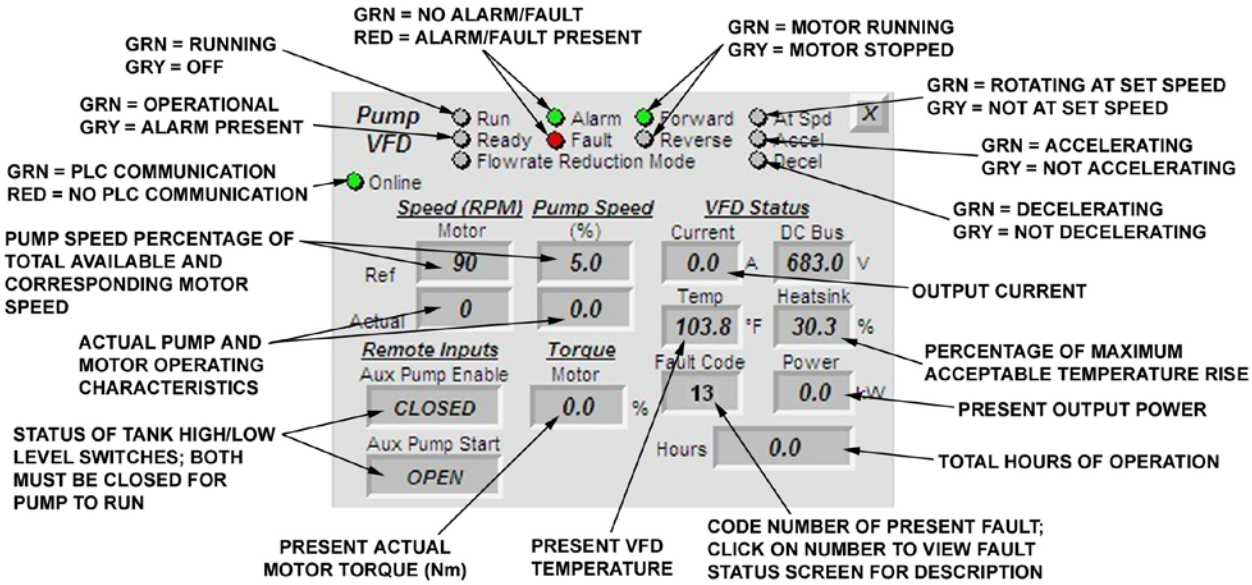


Figure 4-13. Pump VFD Screen

PUMP VFD FAULT STATUS

The three most recent pump faults are shown on the Pump VFD Fault Status screen (Figure 4-14). The screen shows the fault number, time of occurrence, and description of the most recent fault. The fault code and time of occurrence are shown for the second and third most recent faults.

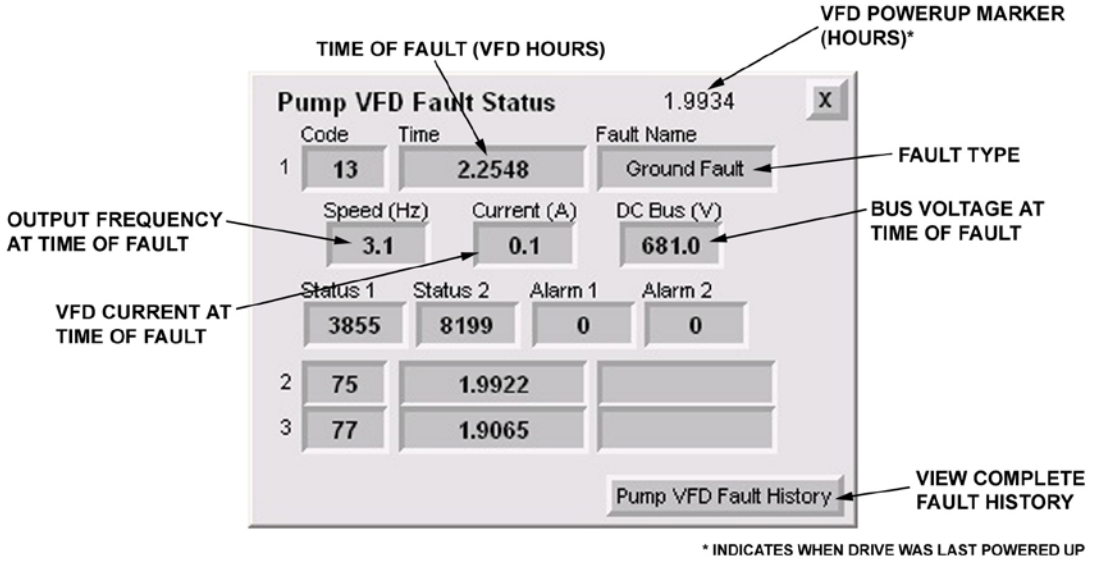


Figure 4-14. Pump VFD Fault Status Screen

TEMPERATURE TRENDS

The historical temperature trends of all three VFDs are shown on the Temperature Trend screen (Figure 4-15). This screen is accessible from the Bowl VFD screen.

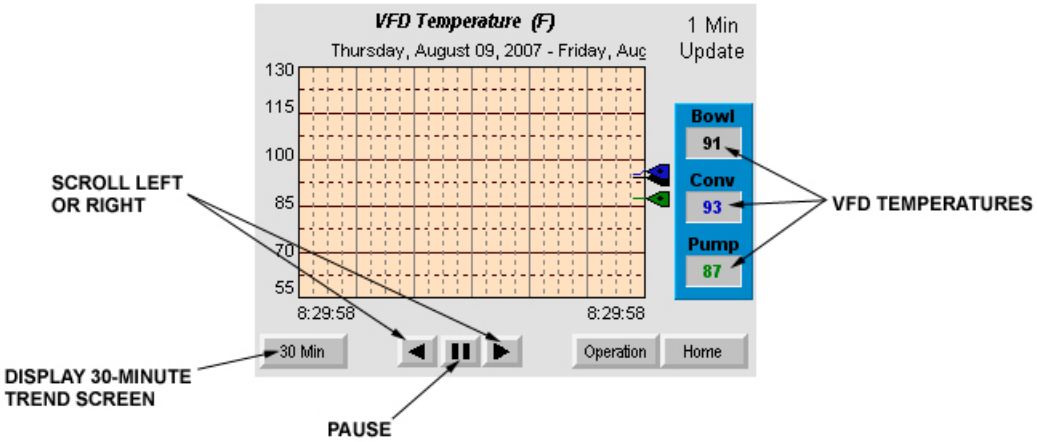


Figure 4-15. VFD Temperature Trend Screen

VFD FAULT RESET

The Fault Reset screen (Figure 4-16) informs the operator of the readiness of each VFD—Faulted or No Fault—and permits resetting a faulted VFD. The screen may be selected from either the Clean Out or Operation screen. If high conveyor torque causes a reduction in the pump flow rate, the message “Flowrate Reduction” is displayed on the Operation or Clean Out screen to inform the operator that the pump is operating at a reduced flow rate. This message also appears on the Fault Reset screen. After removing the cause of the reduced flow rate, RESET is selected on the Fault Reset screen to return the pump to the normal flow rate. After any fault, be sure that the centrifuge has come to a complete stop before attempting to re-start.

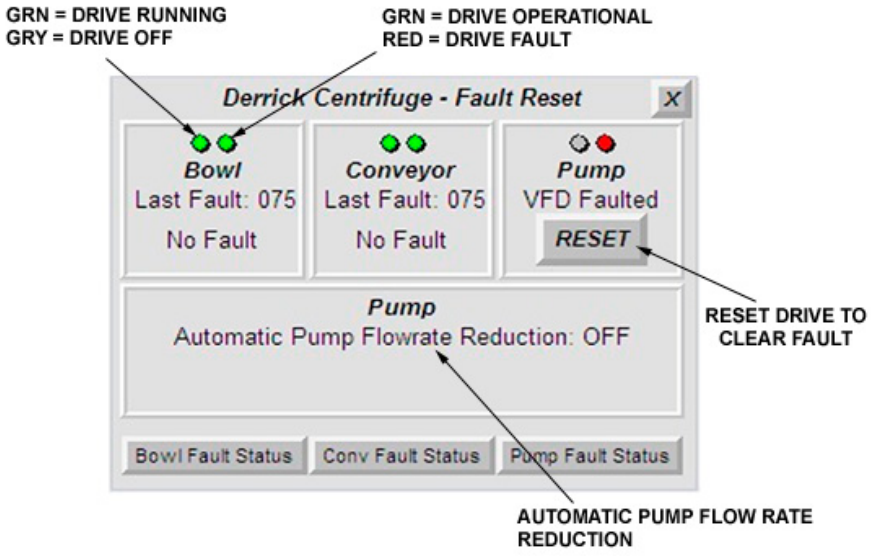


Figure 4-16. Fault Reset Screen

SETUP SCREEN

The Setup screen (Figure 4-17) permits the operator to view the number of the software version installed in the PLC and control panel (HMI), bowl and differential speed settings, and feed pump characteristics; as well as set personal preferences. The operator may adjust the brightness of the control panel screen and select the temperature units (°C or °F) that will be shown on other screens.

Options are provided to select the Login, Diagnostics, or Home screens. If Login is selected, prompting will appear to enter a user name and password, which is available only to authorized personnel. Once the screen is entered, authorized personnel may set or change bowl, conveyor, and pump VFD parameters.

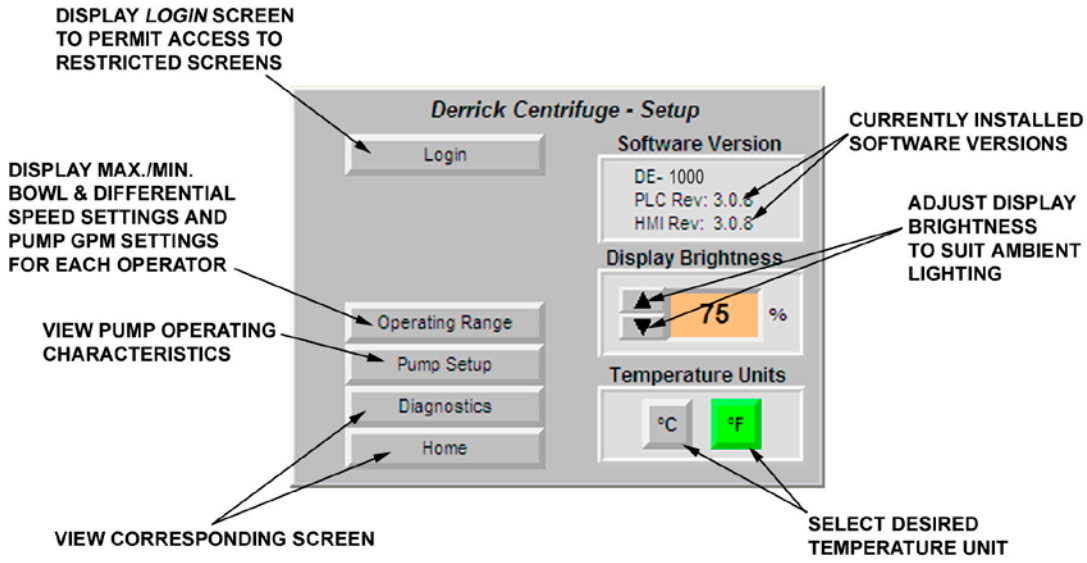


Figure 4-17. Setup Screen

PUMP SETUP SCREEN

The pump operating characteristics are viewed on the Pump Setup screen (Figure 4-18). Information keyed in from the pump and drive motor operating specifications is displayed to inform the operator of current motor and pump information.

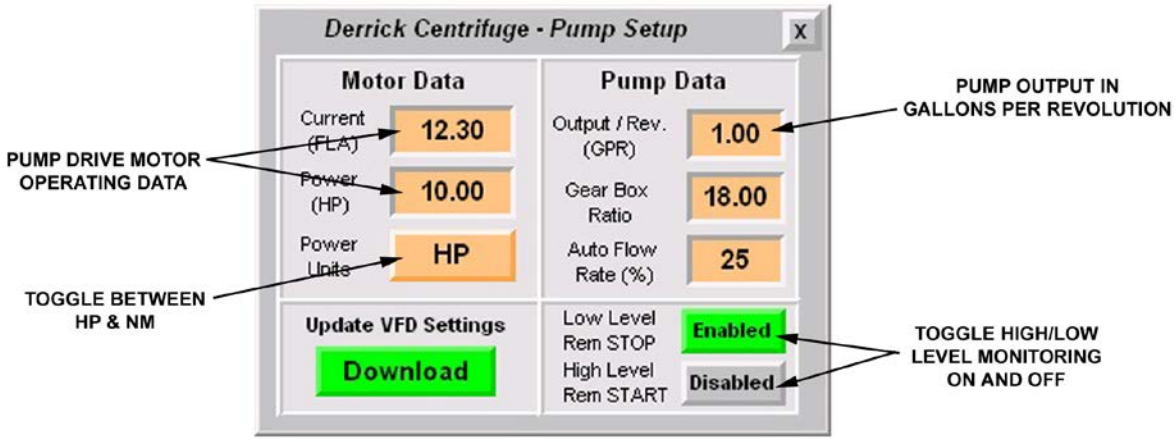


Figure 4-18. Pump Setup Screen

LOGIN

The Login screen (Figure 4-19) is accessed from the Setup screen (Figure 4-14). It permits authorized personnel to enter a password required to display restricted screens. These screens permit supervisory personnel to re-set operating characteristics and thresholds that govern centrifuge operation.

Figure 4-19. Login Screen

CLEAN OUT

The Clean Out screen (Figure 4-20) is used to set parameters for operating the bowl and/or conveyor to remove accumulated process material that is impeding rotation. With this screen displayed, the operator selects the desired bowl and conveyor RPMs for the cleanout process. During cleanout, the actual RPMs and torque percentages are displayed below the setpoints. Provision is included for selecting the automatic or manual cleanout options. When the cleanout process has timed out or was stopped by the operator, the Operation screen or the Faults screen may be displayed.

If automatic reduction of the pump speed is unable to clear out solids from the conveyor, the torque will continue to rise and the centrifuge will shut down. The clean out procedure should then be used to clear out the impacted solids and return the centrifuge to operational status. The following paragraphs explain the two cleanout options: automatic and manual.

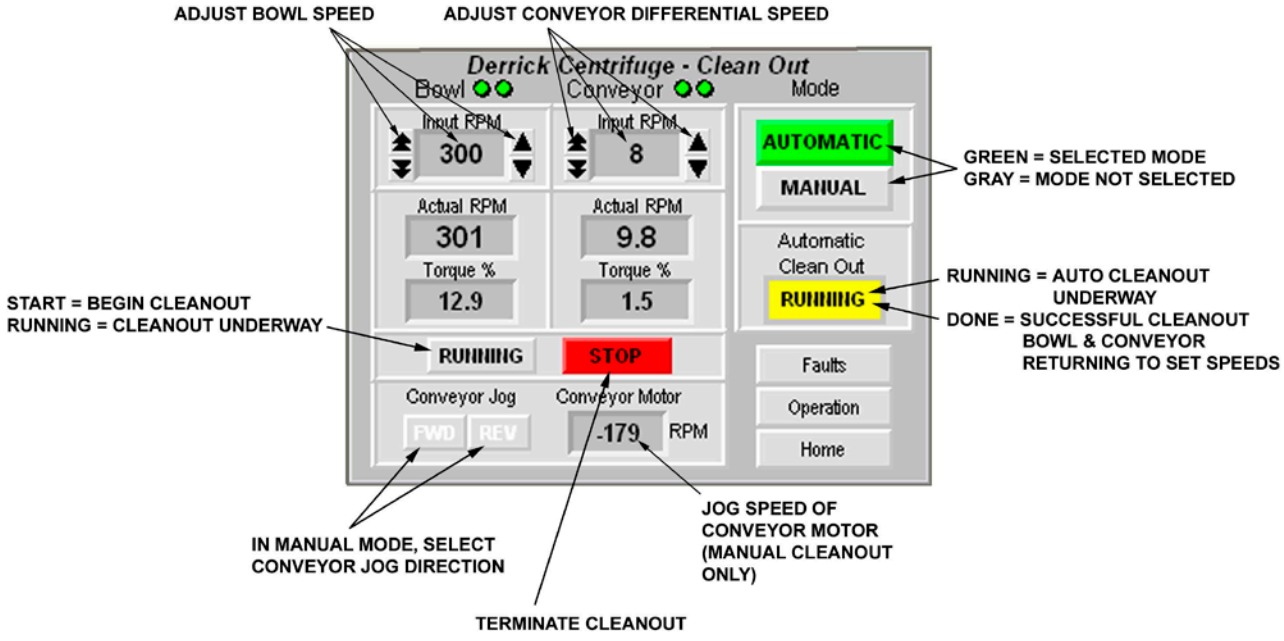


Figure 4-20. Clean Out Screen

Automatic Cleanout

When the automatic option is selected, the system will perform a cleanout cycle for a pre-set duration. The bowl operates in the forward direction at 300 RPM, while the conveyor operates in the forward direction at a speed that varies from 8 to 30 RPM. If excessive resistance is encountered during the cleanout, the system will pause and alert the operator that the automatic cleanout has been unable to clear the centrifuge. Operator intervention is then required to repeat the automatic cleanout operation.

Manual Cleanout

If the manual cleanout option is selected, the operator may elect to jog the conveyor in forward and reverse with the bowl set at zero RPM. If desired, however, the operator may choose to operate the bowl as well as the conveyor. Reverse rotation of the conveyor is governed by a timer that terminates reverse operation after a pre-set interval. The primary purpose of the manual cleanout mode is to permit jogging the conveyor in an effort to remove impacted material.

NORMAL SHUTDOWN

The normal shutdown procedure is to be used for controlled stopping of operation. Normal shutdown is performed for routine activities such as cleaning, lubrication, inspection, or adjustment.

Note! Proper shutdown and flushing of the bowl can prevent high vibration at the next startup.

NORMAL SHUTDOWN	
Step	**Procedure**
1	Stop the feed pump.
2	Initially continue the supply of fresh flushing water to remove all solids from conveyor and bowl. Continue flushing for 3 to 5 minutes after feed pump has been shut down. Regardless of shutdown duration, the conveyor operates at a pre-set differential speed while the bowl decelerates to a stop. This process cleans the bowl during the shutdown. The centrifugal force holds the flushing liquid against the bowl wall during the flushing procedure. As the speed gradually drops during the shutdown period, the solids chute can also be flushed. Fittings on the hinge side of the case permit attachment of a hose to wash the exterior of the rotating assembly and interior of the case assembly.
3	Conveyor gearbox drive motor automatically shuts down when bowl speed falls to less than 200RPM.
4	After the centrifuge comes to a complete stop (which may take more than 15 minutes after interrupting power to the bowl motor), the centrifuge should be restarted for 20 to 30 seconds to clear away solids released during collapse of the water ring.
5	Run automatic cleanout procedure.
6	Open fused disconnect supplying electric power to the machine, and lock out and tag out machine.
7	For cabinet with purge system, turn off compressed air supply to cabinet purge unit.

AUTOMATIC SHUTDOWN

The centrifuge has built-in safety features to protect the equipment. These features will result in automatic shutdown of the centrifuge before damage occurs. The following paragraphs describe these automatic shutdowns.

Excessive Vibration

Excessive vibration of the centrifuge will cause the vibration switch to interrupt electric power to the centrifuge run relay, shutting down the machine. Such excessive vibration may occur during startup or normal operation due to slumping of the wall cake or other unbalanced condition of the bowl. The machine may be re-started by pressing the reset button on the vibration switch and then using the Normal Startup procedure above.

If the machine continually trips during normal startup, flush the bowl with fresh water while running the automatic cleanout routine.

Main Bearing Temperatures

Temperature sensors are installed on the liquid and solid end main bearings and connected to the PLC. Bearing temperatures are continuously displayed on the *Operation* screen. An alarm message is displayed on the control panel when bearing temperature exceeds 225°F (107°C). If temperature rises to 250°F (120°C), a fault message appears and the centrifuge is shut down. Excessively high bearing temperatures usually indicate bearing failure, which can result from inadequate or excessive lubrication, contamination, or severe wear. Refer to Section 5 for main bearing replacement procedure.

Excessive Bowl Speed

A sensor that detects the rotational speed of the bowl provides an input to the PLC that produces a continuous display of actual bowl speed on the Operation and Bowl VFD screens. A fault message is displayed and the centrifuge is immediately shut down if speed rises to 3100 RPM. To re-start the centrifuge, allow the bowl to coast to a complete stop, and check for and remove the cause of excessive speed (refer to Section 5). After correcting defect(s), re-start the machine using the Normal Startup procedure above and re-check speed.

EMERGENCY SHUTDOWN

To stop the centrifuge in case of emergency, press the EMERGENCY STOP button on the control cabinet, select STOP on the Operation screen, or open the fused disconnect supplying electric power to the machine.

Pressing EMERGENCY STOP immediately removes power from the bowl, conveyor, and pump motors, allowing the bowl to coast to a stop. This may take more than 15 minutes depending on the bowl speed and amount of material inside the bowl. To stop the bowl faster, press the STOP button on the Operation screen or display the Bowl VFD screen, and press the BOWL IS COASTING TO A STOP button. However, before pressing this button, all alarms/faults must be cleared.

SECTION 5 - MAINTENANCE

GENERAL

This section describes preventive and corrective maintenance procedures for the DE-1000LP VFD centrifuge. Obvious procedures are omitted. Before beginning any centrifuge maintenance, shut down, lock out, and tag out equipment.

	DANGER! HIGH VOLTAGE! SHUT DOWN, LOCK OUT, AND TAG OUT ELECTRIC POWER, AND ENSURE THAT EQUIPMENT HAS STOPPED ROTATING BEFORE WORKING ON THIS EQUIPMENT.
	WARNING! ALWAYS BE AWARE OF WORK AREA HAZARDS TO PROTECT AGAINST SLIPS, TRIPS, AND FALLS WHEN WORKING ON OR NEAR THIS EQUIPMENT.
	WARNING! LOUD NOISE! WEAR HEARING PROTECTION AT ALL TIMES WHEN WORKING ON OR NEAR THIS EQUIPMENT.
	WARNING! VISION HAZARD! SAFETY GLASSES MUST BE WORN AT ALL TIMES WHEN WORKING ON OR NEAR THIS EQIPMENT TO PREVENT SERIOUS EYE INJURY OR PERMANENT LOSS OF VISION.
	WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO OPERATORS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

TOP COVER OPENING/CLOSING PROCEDURES

The proper procedures for opening and closing the top cover of the centrifuge must always be followed. Two operators using both hands are required to open the cover. Derrick recommends having a hoist available if additional assistance is desired during the opening/closing of the centrifuge cover. To open and close the cover, proceed as follows:

1. Shut down, lock out, tag out electric power to centrifuge, and allow rotating assembly to coast to a full stop.
2. Remove bolts securing cover to base.
3. Have two operators using both hands grip the cover handles securely to ensure full control of the cover throughout the opening and closing process.
4. As the cover is raised, ensure that body limbs of all personnel and any other items remain clear of the cover gap at all times.
5. Raise the cover to the fully opened position, and insert a 1/2” (12.7mm) hardened steel pin through one hinge to lock the cover open.
6. After performing the activity that required the cover to be opened, reverse steps 2 through 5 to close the cover. During the closing procedure, ensure that both operators are capable of controlling the cover’s descent and that all body limbs and other items remain clear of the gap.

PREVENTIVE MAINTENANCE

Preventive maintenance consists of inspection, cleaning, and lubrication. These routine procedures will ensure maximum life and trouble-free operation. While the maintenance schedule presented in this section should remain flexible, modifications should be based on experience with operating the equipment at your facilities. A maintenance log should be kept to help establish a preventive maintenance schedule, as well as to monitor and adjust the schedule as necessary throughout the equipment's life.

When establishing a preventive maintenance schedule, consider duty cycle, ambient temperature, and operating environment. The recommended preventive maintenance schedule is presented in the table below. Refer to the lubrication chart on the following page for applicable lubricants and quantities.

PREVENTIVE MAINTENANCE SCHEDULE	
Action	**Frequency**
Inspect feed tube connection for leaks, and tighten connection clamp as required.	Each shift
Inspect liquid discharge connection for leaks. Tighten connection and/or add silicone sealant to prevent leakage.	Each shift
Grease rotating assembly bearings (Figure 5-1).	One shot each shift
Remove feed tube, clean interior of tube, and reinstall.	Weekly
Inspect gearbox for leakage	Every 2 weeks
Rotate gearbox until fill and overflow plugs are at 12 o'clock position. Remove plugs, fill gearbox until oil drips from overflow, and then reinstall plugs.	Quarterly
Check interior and exterior of case for accumulated solids, and clean as required.	Weekly
Purge conveyor bearings.	Every 2 weeks
Remove belt cover, inspect belt for damage, and check/adjust tension.	Monthly
Remove and clean flinger covers.	Monthly
Grease bowl and conveyor drive motors.	Ten Shots Quarterly

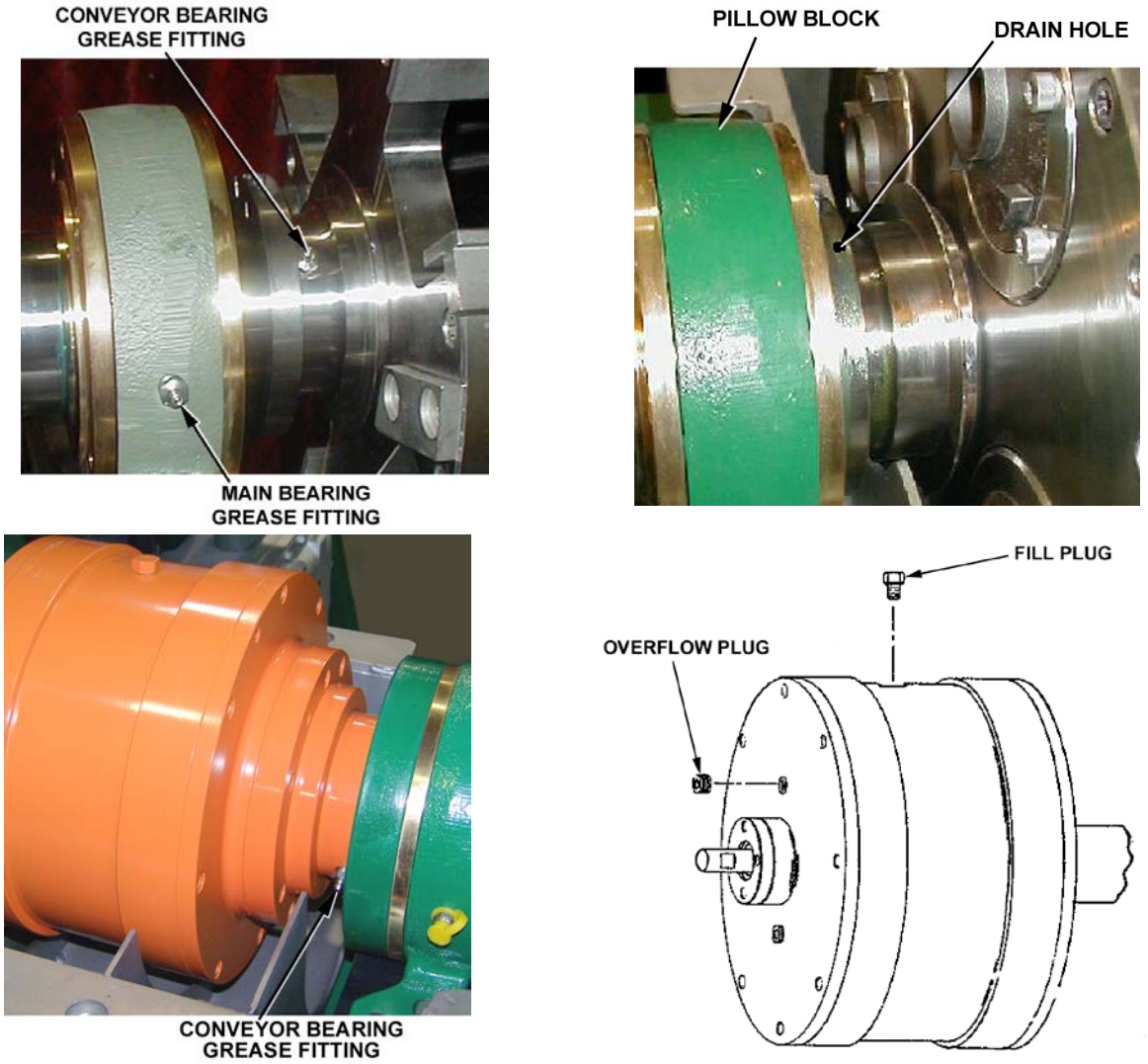


Figure 5-1. Rotating Assembly Lubrication Points

LUBRICATION CHART

The following chart lists the Derrick-approved lubricants for the DE-1000LP VFD centrifuge rotating assembly, gearbox, and drive motors.

DERRICK APPROVED LUBRICANTS - DE-1000LP VFD CENTRIFUGE				
Manufacturer	**Product**	**Application**	**Qty**	**Temp**
OILS				
Shell	Omala 320	Gearbox	80 Oz.	Standard
Exxon Mobil	SHC 220	Gearbox	80 Oz.	Arctic
GREASES				
Chevron	SRI NLGI 2 SRI-2	Main & Conveyor Bearings	A/R	Standard
Shell	Aeroshell 14	Main & Conveyor Bearings	A/R	Arctic
Chevron	SRI NLGI 2 SRI-2	Motor Bearings (Main & Conveyor)	A/R	Standard
Shell	Aeroshell 14	Motor Bearings (Main & Conveyor)	A/R	Arctic
Exxon Mobil	FM 102 (Food Grade)	Conveyor Bearings Only	A/R	Standard

DRIVE BELT REPLACEMENT

DANGER! HIGH VOLTAGE! SHUT DOWN, LOCK OUT, AND TAG OUT ELECTRIC POWER, AND ENSURE THAT EQUIPMENT HAS STOPPED ROTATING BEFORE WORKING ON THIS EQUIPMENT.

WARNING! VISION HAZARD! SAFETY GLASSES MUST BE WORN AT ALL TIMES WHEN WORKING ON OR NEAR THIS EQIPMENT TO PREVENT SERIOUS EYE INJURY OR PERMANENT LOSS OF VISION.

The drive belt should be replaced if inspection reveals damage or deterioration. To replace the belt, proceed as follows:

1. Loosen screws securing feed tube clamp, and slide out feed tube.
2. Release latches, and remove belt guard covering sheaves.
3. Loosen bolts securing bowl drive motor mounting plate to base (Figure 5-2), lift motor to loosen belt, and slip belt off sheaves.
4. Check sheave parallel alignment using a straight edge. Adjust position(s) of sheave(s) to achieve parallel alignment within 0.0156” (0.4mm).
5. Install new belt on drive motor and bowl assembly sheaves.
6. Move motor mount downward in the adjusting slots to apply sufficient belt tension to permit deflection of 5/8” (16mm) with 20 lbs of pressure exerted at the midpoint of the belt. After correct tension is set, tighten motor mount bolts.
7. Install belt guard, and latch in place.
8. Insert feed tube into feed tube support until shoulder fully contacts support, and tighten screws to specification listed in *Hardware Torque Specifications*.

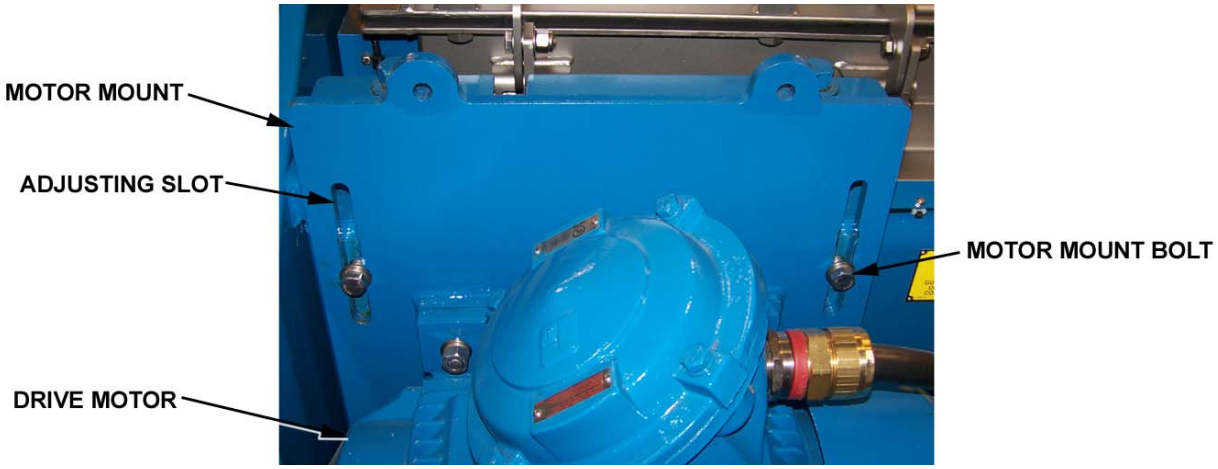


Figure 5-2. Drive Belt Tensioning

PURGE SYSTEM

Bypassing Purge System

The purge unit may be bypassed when necessary to apply electric power to the centrifuge while the control cabinet door is open, but **this should be done only after verifying that the centrifuge is in a non-hazardous area**. After completing the work, the purge system must be restored to operation and satisfactory operation confirmed. Refer to Section 4 for the purge bypass procedure.

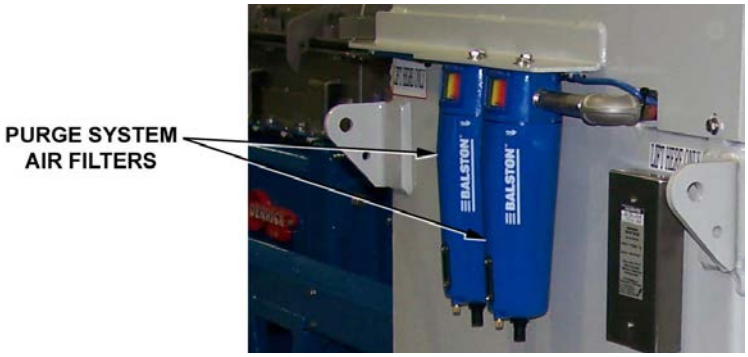
⚠	**WARNING! USE EXTREME CAUTION WHEN WORKING ON EQUIPMENT WITH PURGE SYSTEM BYPASSED. DANGEROUSLY HIGH VOLTAGE WILL BE PRESENT IN ELECTRICAL PANEL AND CONTROL CABINET IF POWER IS APPLIED.**
⚠	**WARNING! FAILURE TO WEAR SAFETY GLASSES MAY RESULT IN SERIOUS EYE INJURY OR PERMANENT LOSS OF VISION. SAFETY GLASSES MUST BE WORN AT ALL TIMES WHILE PERFORMING ANY MAINTENANCE PROCEDURE.**

Inspection and Test Procedures

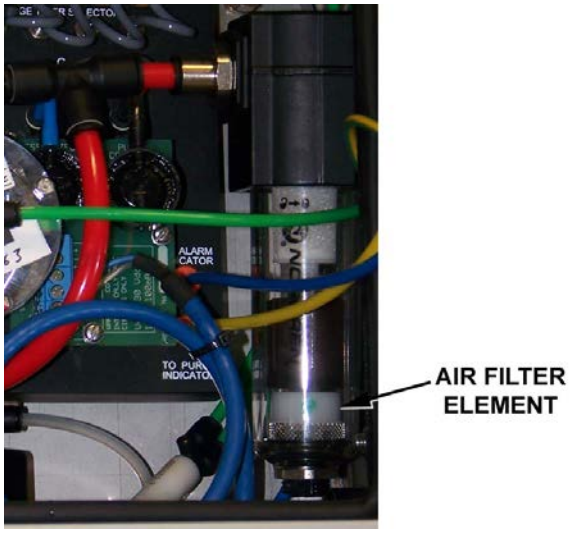
Periodic inspection and test procedures, supplemented by any additional requirements imposed by local codes, are recommended. The following tests should be performed at least every 6 to 24 months depending on site conditions.

Visual Inspection and Checks

1. Inspect condition of relief valve and spark arrestor. Remove all debris and corrosion or replace relief valve.
2. Check/drain air supply filters on cabinet exterior.



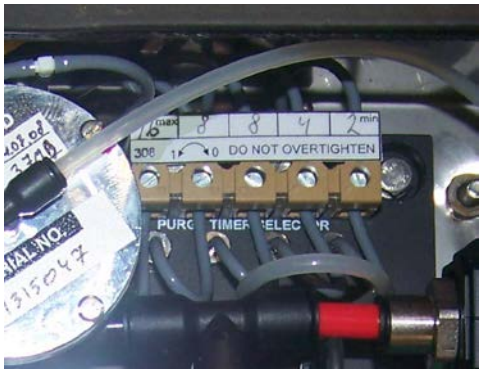
3. Check condition of the purge unit air filter element, and clean or replace as necessary.



4. At least every two years, check the following additional items:
   a. Apparatus is suitable for the hazardous location.
   b. There are no unauthorized modifications.
   c. Quality of the air supply is correct (refer to *Compressed Air* in Section 3).
   d. Approval labels are legible and undamaged.
   e. Power to the centrifuge is shut down upon loss of air pressure.

Initial Purge Time Setting

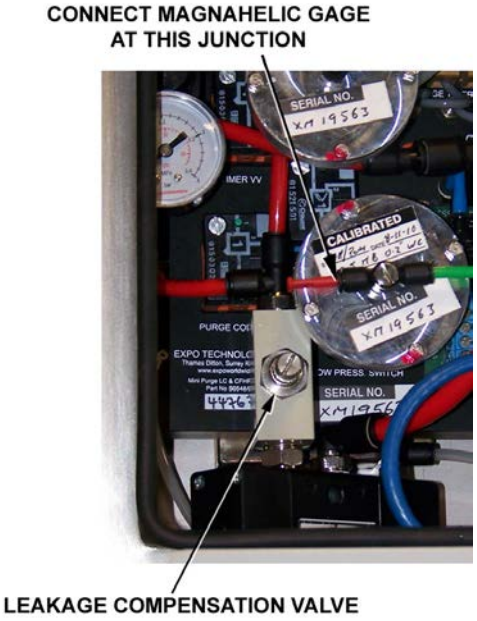
The initial purge time is factory-set to 14 minutes. If purge time varies excessively, the digital timer system inside the purge unit may be adjusted to restore the correct interval. The time intervals marked on each valve are additive. In the photo below, the timer shows that total purge time available is 38 minutes (16+8+8+4+2). If testing reveals that purge time has varied from this setting, the purge time should be changed by opening or closing one or more valves. When making an adjustment, note that valves are either open or closed; no intermediate setting is possible.



Leakage Compensation Test

A Magnahelic gage and hose kit available from Derrick is required to monitor cabinet pressure. The leakage compensation valve adjustment should be checked for deviation from factory setting as follows:

1. SLOWLY open the supply regulator or leakage compensation valve, and allow the cabinet pressure to rise until the relief valve opens. Check that the relief valve opens at or below 7" ±0.8" WC (17.4 mbarg ±2 mbarg).
2. Repeat the relief valve test several times.
3. Open the supply regulator to between 60 and 115 psi (4 and 8 barg) to start the purge flow.
4. Check that the internal logic gage reads 30 psi (2 bar).
5. At this time the ALARM/PRESSURIZED indicator should be green and the PURGING indicator should be amber. If the amber indicator remains off, the flow through the relief valve is below the minimum for which the flow sensor has been calibrated. Check the air supply pressure at **the inlet to the control unit while purging is taking place**. It must be above the minimum specified pressure.



Leakage Compensation Test (Cont'd)

6. The purge timer will start as soon as the PURGING indicator turns amber. Check that the time delay between the PURGING indicator turning amber and the application of power to the control cabinet is not less than the minimum time required for purging the cabinet. Times in excess of the minimum are permitted, and a tolerance of +20% is normally acceptable. If the time is too short it must be increased accordingly.

7. After power has been applied via the control unit the purging valve will close, and the air flow into the cabinet will be controlled by the leakage compensation valve. The setting of the leakage compensation valve should now be checked. One of the following three conditions will be occurring:

   a. If a considerable quantity of air continues to flow out the relief valve after power has been applied, the leakage compensation valve is too far open and the air flow is holding the relief valve open continuously. To correct this condition, slowly close the leakage compensation valve. The cabinet pressure will start to fall as the flow decreases but eventually the relief valve will close, and the cabinet pressure will rise again. At this point, the relief valve may start to open intermittently as the cabinet pressure rises to the point where it exceeds the relief valve opening pressure. When the relief valve opens, the pressure will fall quickly to the point where the relief valve re-closes and the cabinet pressure starts to rise again.

   b. If the relief valve is opening intermittently, the leakage compensation valve is open slightly too far. When the relief valve opens, the cabinet pressure falls quickly to the point where the relief valve re-closes and the cabinet pressure starts to rise again. Continue to close the leakage compensation valve until the cycling stops and the cabinet pressure starts to fall. Carefully adjust the leakage compensation valve until the cabinet pressure is stable. This pressure will be the normal working pressure and should be about 5" WC (12.5 mbarg).

   c. If, at the end of purging, the cabinet pressure falls below the minimum pressure sensor setting and the leakage compensation valve is fully open, the system will start to purge again. This indicates excessive leakage from the cabinet. In this case, check the cabinet for leakage, and reduce or eliminate the leaks. After sealing cabinet leakage, at the end of purging the cabinet should stay pressurized and the relief valve action will be as in a or b, above. Proceed with adjustments described in the preceding steps.

Note! When air conditioner goes off, the relief valve may vent momentarily. This is normal.

Minimum Pressure Sensor Setting

The setting of the minimum pressure sensor should be checked as follows:

1. Note the position of the leakage compensation valve knob by marking knob with a pencil at the 12:00 o'clock position.

2. Slowly lower the cabinet pressure by closing the leakage compensation valve further, counting the number of turns from the normal working pressure position. Note the pressure at which the alarm/pressurized indicator changes from green to red, and check that this pressure is not lower than 0.2" WC (0.5 mbar). Check also that the ALARM electrical contacts function properly.

3. As soon as the ALARM/PRESSURIZED indicator turns red, the system will begin re-purging, and the enclosure power will be switched off.
4. While the cabinet is re-purging, return the leakage compensation valve to its normal working pressure position so that at the end of purging the cabinet pressure should immediately settle down at the correct normal pressure.

Pressure Sensor Calibration

If it is decided that the minimum pressure sensor requires recalibration, it must be returned to Derrick for this service.

Cleaning Purge Unit Filter

Do not use solvents on any part of the purge unit filter assembly. To clean the filter element, unscrew and remove the filter bowl and then unscrew and remove filter element. Clean filter element in soapy water or replace element.

ROTATING ASSEMBLY MAINTENANCE

Maintenance of the rotating assembly is limited to cleaning, inspection, and replacement of wear inserts. Excessive noise or vibration during centrifuge operation may indicate defective main or conveyor bearings. If such conditions are evident, the bearings should be inspected for looseness. The rotating assembly must be replaced if main or conveyor bearings are found, or if internal damage to the rotating assembly is found or suspected. The damaged rotating assembly should be returned to Derrick for overhaul.

Removal

The rotating assembly must be removed for thorough cleaning and inspection. To remove the rotating assembly, proceed as follows:

1. Shut down, lock out, and tag out electric power to the centrifuge.

WARNING! ALWAYS ALLOW MACHINE TO COAST TO A COMPLETE STOP BEFORE OPENING COVER OR REMOVING GUARDS.

WARNING! WHILE OPENING AND CLOSING THE CENTRIFUGE COVER, PERSONNEL MUST ENSURE THAT ALL BODY LIMBS AND ANY OTHER ITEMS ARE CLEAR OF THE COVER GAP. TWO OPERATORS MUST BE USED, WITH BOTH HANDS ON THE COVER HANDLES AT ALL TIMES. DERRICK RECOMMENDS HAVING A HOIST AVAILABLE IF ADDITIONAL ASSISTANCE IS DESIRED DURING THE OPENING/CLOSING PROCEDURE.

2. After bowl assembly has coasted to a full stop, loosen screws securing case cover until screws are disengaged from lower case, and raise cover.
3. Remove feed tube and drive belt.
4. Remove top cover from gearbox enclosure.
5. Attach a suitable lifting strap and hoist to conveyor drive motor.
6. Remove screws securing both halves of flexible coupling to shafts of conveyor drive motor and gearbox, and remove coupling halves (Figure 5-3).

Removal (Cont'd)

Figure 5-3. Conveyor Drive Flex Coupling

7. Remove nuts and washers securing conveyor drive motor to mounting base, and lift and remove motor.
8. Remove the gearbox as follows:
   a. Remove six screws securing gearbox (Figure 5-4) to flange.
   b. Install two 3/8"-16 jack screws into gearbox flange clearance holes, and alternately turn both jack screws a few revolutions at a time to begin separating gearbox from flange.
   c. Support gearbox during remainder of procedure using a lifting strap and suitable hoist.
   d. Fully separate gearbox from flange by alternately turning jack screws until unit is fully detached.
   e. With gearbox supported by lifting strap and overhead lifting device, **CAREFULLY** slide gearbox outward until splined shaft is free of conveyor. Place gearbox in plastic bag to prevent contamination.
9. Tighten nuts on pillow block alignment pins to jack out pins, and remove pins.
10. Remove bolts securing pillow blocks to base mounting pads.
11. Attach lifting straps at two locations on rotating assembly and, using a hoist capable of supporting approximately 2000 lbs (910kg), lift and remove rotating assembly from case.
12. Note locations of all shims found between pillow blocks and base mounting pads, and remove and retain shims.
13. Apply protective coating to mating surfaces of pillow blocks and base.

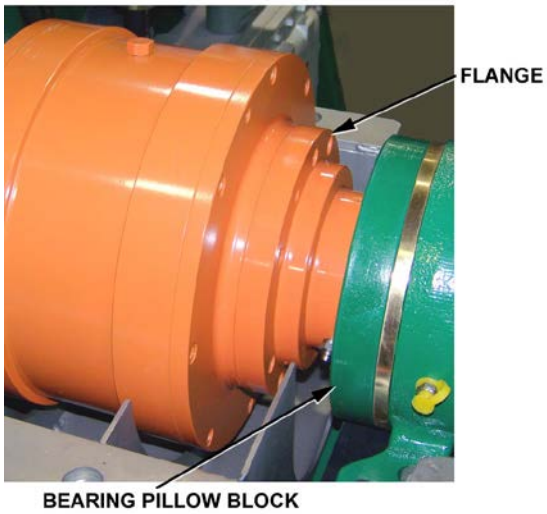


Figure 5-4. Gearbox Removal

Cleaning, Inspection, and Repair

1. Wash off mud and debris from conveyor and interior and exterior of bowl assembly.
2. Inspect solid discharge wear inserts on bowl assembly for cracks, fractures, or other damage, and replace if seriously damaged.
3. Inspect bowl exterior for gouges, scratches, or other damage that may affect performance.
4. Check pillow block bearings and conveyor bearings for looseness, noise, or rubbing. If bearing looseness or damage is found, replace rotating assembly in accordance with procedures in this section. Return defective rotating assembly to Derrick for overhaul.
5. Remove inspection plug from bowl extension, and insert vernier caliper through hole and into contact with conveyor flight (Figure 5-5). If measurement is 1" (25.4mm) or more, the conveyor is worn excessively, and the rotating assembly should be returned to Derrick for overhaul.

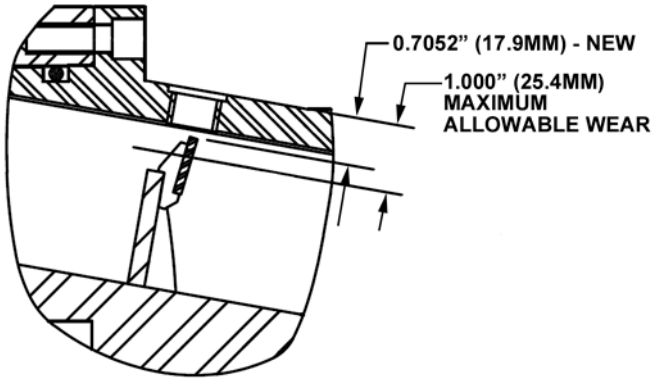


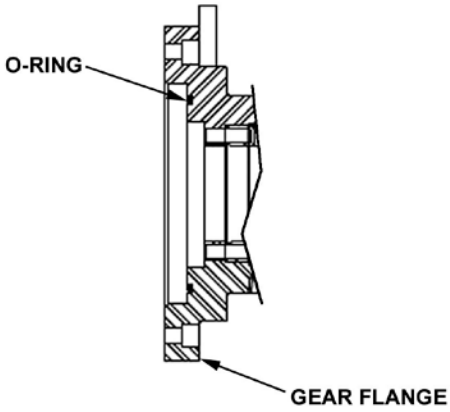
Figure 5-5. Conveyor Flight Wear Measurement

Installation

1. Remove all nicks and/or burrs from pillow blocks and mating surfaces. Clean all surfaces of any protective coating applied after removal.
2. Reinstall shims in proper locations, as noted during removal.

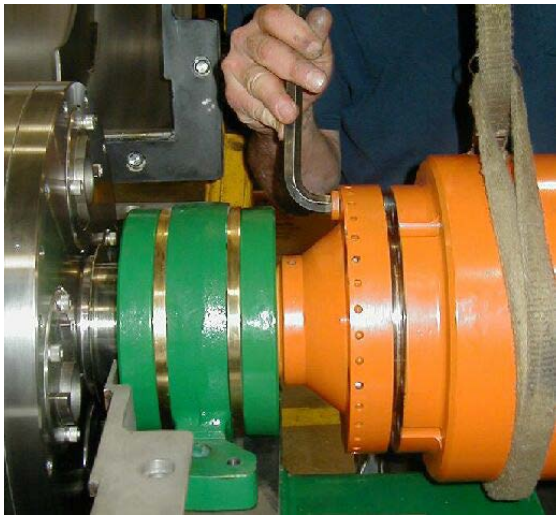
Installation (Cont'd)

3. Clean alignment pins before reinstalling, and apply anti-seize compound.
4. Orient rotating assembly to horizontal position, and carefully lower into case until about 1/2" (13mm) above base.
5. Insert bolts through pillow blocks, and start threads into base. Do not tighten bolts.
6. Lower rotating assembly fully onto base.
7. Insert alignment pins through pillow blocks, and lightly tap into holes to fully align pillow blocks with base mounting holes.
8. Tighten bolts in accordance with applicable specification in *Hardware Torque Specifications* to secure pillow blocks to base.
9. Install gearbox as follows:
   a. Insert new O-ring into groove in face of gear flange, and apply grease to shaft to facilitate installation. Place lifting strap on gearbox, and, using an overhead lifting device **CAREFULLY** lift and position gearbox to engage splined shaft with internal spline of conveyor.



   b. Insert six new hex head screws through gear flange and into threaded mounting holes of gearbox. Alternately turn each screw a few revolutions at a time to evenly draw the gearbox and flange together.

      Tighten the mounting screws using a star pattern typical for circular bolt patterns. Refer to *Hardware Torque Specifications* for torque values.



10. Inject grease into conveyor bearing until grease escapes from drain hole located between pillow block and liquid bowl head. Wipe off surplus grease, and distribute grease by rotating liquid bowl head one revolution clockwise and then one revolution counterclockwise.
11. Check and adjust runout of outside diameter of gearbox as described in the steps below. Axial runout may not exceed 0.002" (0.05mm) total indicator reading (TIR).

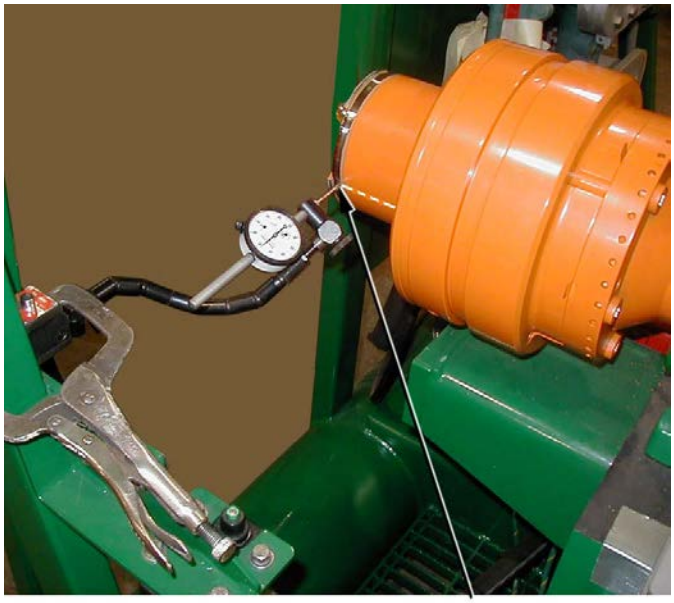
12. To measure and adjust runout, proceed as follows:

a. Clean surface of gearbox where dial indicator plunger will make contact.

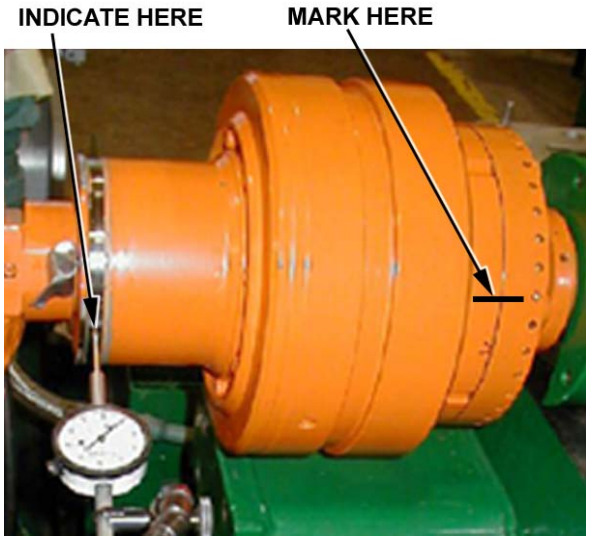
b. Install indicator holder with magnetic base in either position shown.

c. Position plunger of dial indicator into contact with outside diameter at horizontal centerline of gearbox.

d. Manually rotate the gearbox until dial indicator is at its lowest reading, and zero out dial indicator.

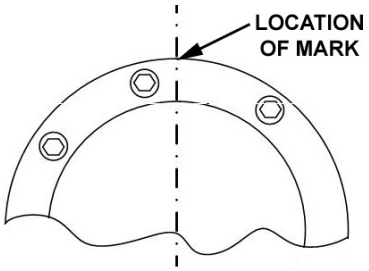


e. Manually rotate the gearbox until reading on dial indicator is highest; mark across gearbox and flange along axial centerline where surfaces mate.



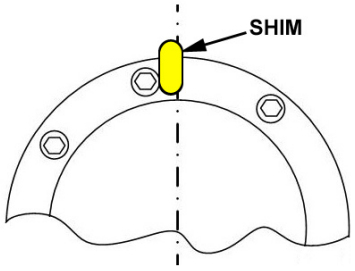
f. Manually rotate gearbox until mark made in step e is at top.

g. Loosen hex head screw closest to mark as well as both screws to each side of the mark.



h. Insert shim having approximate thickness of dial indicator measurement between flange and gearbox. Shim should barely contact threads of screw hole closest to mark made in step e.

i. Tighten screws loosened in step g.



j. Repeat steps d through i, if required, until TIR does not exceed 0.002” (0.05mm).

k. Trim projecting shim stock.

13. After completing gearbox installation, install top cover over gearbox.

14. Install drive belt, and apply adequate tension to prevent slippage.

15. Install feed tube and secure in its support.

16. Close cover, and secure by tightening screws.

TOOL LIST

The following tool list includes all tools and equipment supplied to facilitate maintenance of the DE-1000LP VFD centrifuge. Each component is listed with its part number, quantity supplied, and use or application.

DE-1000LP VFD CENTRIFUGE TOOL LIST		
PART NO.	**DESCRIPTION / *APPLICATION***	**QTY**
Allen-33212	Long-Arm Allen Wrenches, 3/32” to 1/2” *Various rotating assembly hardware*	1
G0008667	Socket, 15/16”, 1/2” Drive *Remove and install pillow block bolts*	1
OTC-1039	Bearing Puller, 2-Jaw, 10” Reach, 0” to 12” Spread *Remove main bearing inner race from liquid bowl head shaft*	1
HXCBF38-16X250	Hex Head Jack Bolt, 3/8-16 x 2-1/2” Long *Separate gearbox from flange*	2
HXCBF31-18X400	Hex Head Jack Bolt, 5/16-18 x 4” Long *Separate conveyor bearing housing from liquid end bowl head shaft*	4

DE-1000LP VFD CENTRIFUGE TOOL LIST		
PART NO.	**DESCRIPTION / *APPLICATION***	**QTY**
HXCBF38-16X400	Hex Head Jack Bolt, 3/8-16 x 4" Long *Separate conveyor bearing housing from solid end bowl head shaft*	4
10792-00	Vertical Lifting Bracket *Lift solid end bowl head and conveyor from bowl assembly*	1
10791-00	Vertical Stand *Support liquid bowl assembly vertically during maintenance*	1
WFSS-31	5/16" Flat Washers *Attach vertical lifting bracket to gearbox flange*	6
NHHS-31-18	Hex Nut, Heavy, 5/16-18 *Attach vertical lifting bracket to gearbox flange*	6
SKCS-38-16x175	Socket Hd Cap Screw, 3/8-16 x 1-3/4" *Attach vertical lifting bracket to gearbox flange*	4
G0004114	Socket Hd Cap Screw, 5/16-18 x 1-1/4" *Attach vertical lifting bracket to solid end bowl head*	6
RED-B150X125	Bushing, Hex, 1-1/4" x 1-1/2" *Reduce opening of feed tube*	1
CHE-SRI-2	Grease, Standard* *Lubricate main bearings and gearbox spline*	1
Aeroshell GR-14	Grease, Arctic* *Lubricate main bearings and gearbox spline*	1
EYE-S31-18X113	Eye Bolt, 5/16-18 x 1-1/8" *Lift rotating assembly by gearbox flange*	2
PP1127	Grease Gun, 1/2" Dia. Hose, 14.5 Oz *Inject grease into gearbox and main bearing fittings*	2

* Appropriate grease included per climate and customer requirements

HARDWARE TORQUE SPECIFICATIONS

Use only hardware that is approved by Derrick Corporation. The use of potentially inferior, non-Derrick approved hardware may result in serious injury to personnel and/or damage to equipment. Additionally, any warranty in force, whether written or implied, may be voided by use of unapproved hardware. Contact Derrick Corporation with questions pertaining to hardware type and usage associated with Derrick centrifuges.

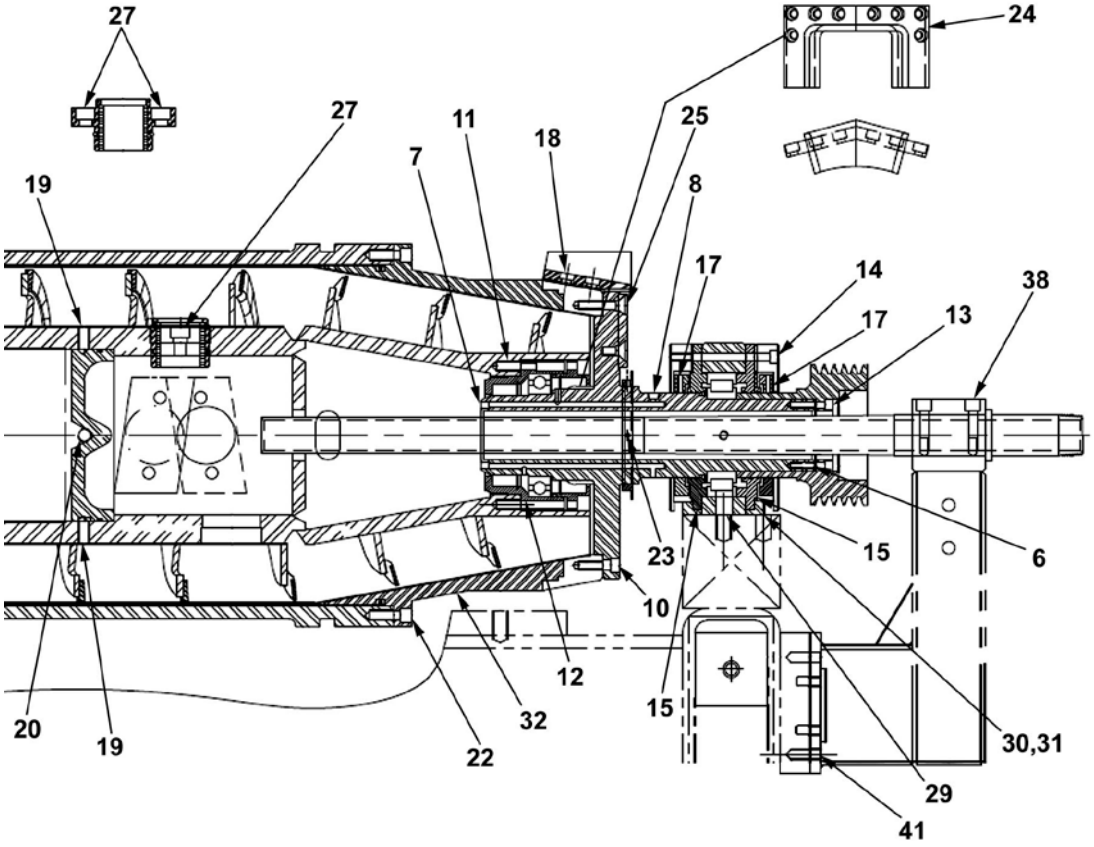
WARNING! USE OF INFERIOR, NON-DERRICK APPROVED HARDWARE MAY RESULT IN SERIOUS INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.

Recommended seating torque specifications, lubricants, and other hardware installation specifications for the various types and sizes of hardware used on the centrifuge are shown and described on the following pages.

HARDWARE TORQUE SPECIFICATIONS (CONT'D)

Use the following procedure when tightening hardware:

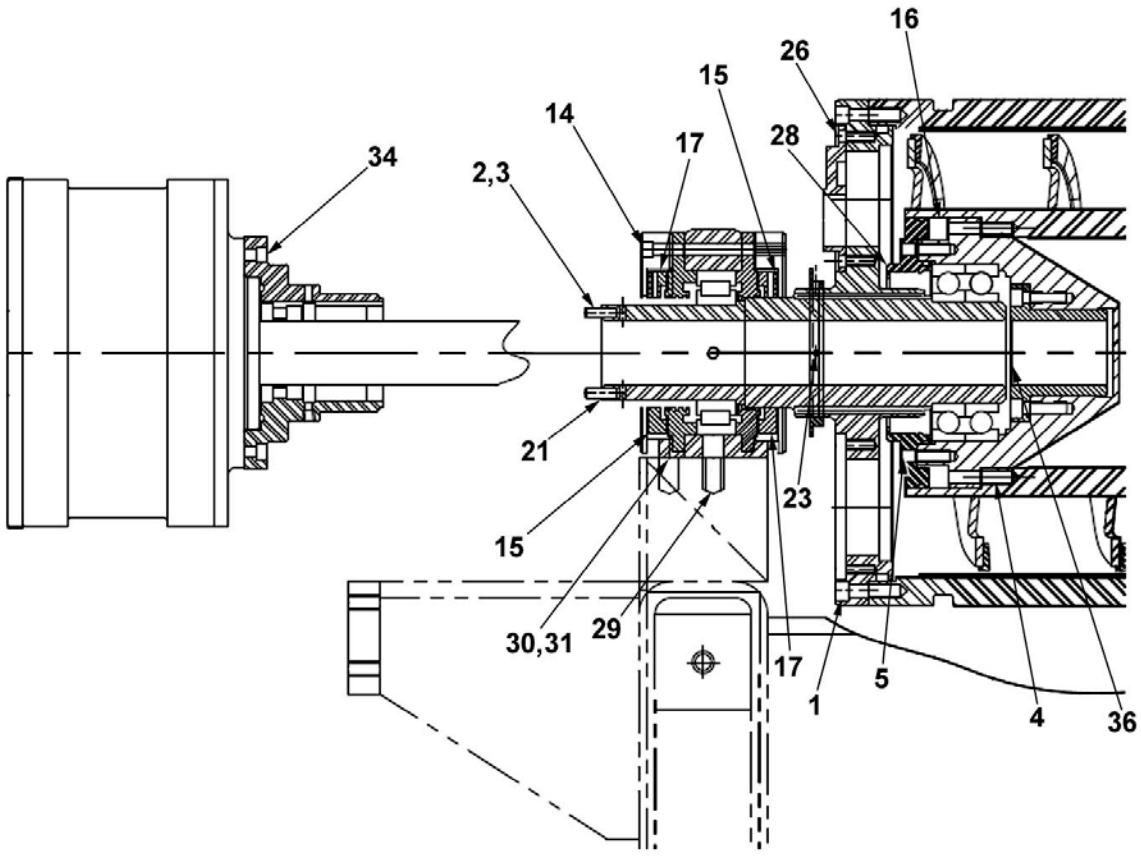
1. Use only a calibrated torque wrench.
2. Apply specified lubricant to hardware before installing.
3. When tightening more than one bolt, alternate tightening between bolts.
4. Always approach the final torque in several stages.



SOLID END HARDWARE LOCATIONS

SOLID END HARDWARE TORQUE SPECIFICATIONS					
No.	**Description**	**Qty**	**Lubricant**	**Torque**	**Location**
6	1/4 x 1-1/4 Pin	4	Loctite 680	N/A	Solid End Bowl Head
7	5/16-18 x 1/2 Set Screw	2	Loctite 262	N/A	Solid End Bowl Head
8	1/8 NPT x 3/4 Grease Fitting	2	N/A	N/A	Solid End Bowl Head
10	3/8-16 x 1 Hx Skt Hd	8	Anti-Seize	252 in lb/28.5Nm	Solid End Bowl Head
11	5/16-18 x 3 Hx Skt Hd	6	Anti-Seize	144 in lb/16.3Nm	Solid End Seal Housing
12	1/4 x 1 Pin	1	Loctite 680	N/A	Solid End Bearing Housing
13	1-4-20 x 1 Hx Skt Hd	8	Anti-Seize	83 in lb/9.4Nm	Pulley Sheave
14	5/16-18 x 4 Hx Hd	6	Anti-Seize	Unspecified	Flinger Cover
15	3/8-16 x 1 Flt Hd Hx Skt	16	Anti-Seize	183 in lb/20.7Nm	Pillow Block Cover
17	1/4-20 x 5/8 Hx Skt Hd	4	Anti-Seize	144 in lb/16.3Nm	Pillow Block Flinger

SOLID END HARDWARE TORQUE SPECIFICATIONS					
No.	**Description**	**Qty**	**Lubricant**	**Torque**	**Location**
18	3/8-16 x 3/4 Hx Skt Hd	8	Anti-Seize	252 in lb/28.5Nm	Case Plows
19	3/8-16 x 1 Set Screw	2	Anti-Seize	75 in lb/8.5Nm	Feed Accelerator Bump
20	1/2-13 x 1 Set Screw	1	Anti-Seize	265 in lb/30Nm	Feed Accelerator Bump
22	3/8-16 x 1 Hx Skt Hd	12	Anti-Seize	252 in lb/28.5Nm	Bowl Extension
23	10-24 x 1/4 Set Screw	2	Anti-Seize	N/A	Case Flinger
24	5/16-18 x 3/4 Hx Skt Hd	32	Anti-Seize	144 in lb/16.3Nm	Wear Inserts
25	3/8-16 x 3/4 Flt Hd Hx Skt	4	Anti-Seize	183 in lb/20.7Nm	Solid Head Plows
27	1/2-13 x 1 Hx Skt Hd	8	Anti-Seize	53 in lb/0.4Nm	Feed Nozzle
29	5/8-11 x 2-1/4 Hx Hd	4	Anti-Seize	197 ft lb/267Nm	Pillow Block
30	#8 Pin (7/16-20 x 2-1/2)	4	Anti-Seize	N/A	Pillow Block
31	#7 Pin (3/8-24 x 2-1/2)	4	Anti-Seize	N/A	Pillow Block
32	#8 Plug	1	Anti-Seize	35 ft lb/47.5Nm	Bowl Extension
38	3/8-16 x 2-1/2 Hx Hd	4	Anti-Seize	Unspecified	Feed Tube Mounting Block
41	3/8-16 x 1-1/2 Hx Hd	4	Anti-Seize	Unspecified	Feed Tube Support Flange



LIQUID END HARDWARE LOCATIONS

LIQUID END HARDWARE TORQUE SPECIFICATIONS					
No.	**Description**	**Qty**	**Lubricant**	**Torque**	**Location**
1	3/8-16 x 1-1/4 Hx Skt Hd	12	Anti-Seize	252 in-lb/28.5Nm	Liquid End Bowl Head
2	5/16 x 1 Pin	*	Loctite 680	N/A	Liquid End Bowl Head
3	5/16 x 5/16 x 3 Key	1	N/A	N/A	Liquid End Bowl Head
4	3/8-16 x 1-1/2 Hx Skt Hd	8	Anti-Seize	252 in lb/28.5Nm	Liquid End Bearing Housing
5	3/8-16 x 1 Hx Skt Hd	4	Anti-Seize	252 in lb/28.5Nm	Liquid End Seal Housing
8	1/4 NPT x 3/4 Gr. Fitting	2	N/A	N/A	Liquid End Bowl Head
14	5/16-18 x 4 Hx Hd	6	Anti-Seize	Unspecified	Flinger Cover
15	3/8-16 x 1 Flt Hx Skt Hd	16	Anti-Seize	183 in lb/20.7Nm	Pillow Block Cover
16	3/8-16 x 1 Hx Skt Hd	8	Anti-Seize	252 in lb/28.5Nm	Spline Hub
17	1/4-20 x 5/8 Hx Skt Hd	4	Anti-Seize	144 in lb/16.3Nm	Pillow Block Flinger
21	5/16-18 x 1 Hx Skt Hd	*	Loctite 262	300 in lb/34Nm	Gearbox Flange
23	10-24 x 1/4 Set Screw	2	Anti-Seize	N/A	Case Flinger
26	5/16-18 x 7/8 Hx Skt Hd	12	Anti-Seize	144 in lb/16.3Nm	Effluent Port
28	3/8-16 x 1/2 Set Screw	2	Anti-Seize	N/A	Seal Housing
29	5/8-11 x 2-1/4 Hx Hd	4	Anti-Seize	197 ft lb/267Nm	Pillow Block
30	#8 Pin (7/16-20 x 2-1/2)	4	Anti-Seize	N/A	Pillow Block
31	#7 Pin (3/24-20 x 2-1/2)	4	Anti-Seize	N/A	Pillow Block
34	5/16-18 x 3/4 Hx Skt Hd	6	Anti-Seize	N/A	Gearbox to Gearbox Flange
36	3/8 x 1 Pin	2	Loctite 680	N/A	Spline Hub

*****2 - 4 on Serial numbers below CF000272
2 on serial numbers CF000272 thru CF000678
0 on serial numbers above CF000979

*****21 - 4 on serial numbers below CF000272
6 on serial numbers CF000272 thru CF000678
9 on serial numbers above CF000679

RECOMMENDED SPARE PARTS

Defective parts should be replaced as soon as possible to restore the equipment to full operational status. Refer to the engineering drawings in Section 8 for Derrick component locations and part numbers.

The following table lists the recommended spare parts required to support a single DE-1000LP VFD centrifuge for two years. However, since all potential part replacements cannot be predicted, the complete spare parts inventory should be based on the user's experience with similar equipment.

RECOMMENDED SPARE PARTS - DE-1000LP VFD CENTRIFUGE			
Part No.	**Description**	**Consumable**	**Qty**
Mechanical			
G0008378	Magnahelic Gage and Hose Kit, 0-10” WC	No	1
G0009762	Drive Belt	Yes	1
C000-RA-110-00	Grease, High Speed, Main Bearing, 16 Oz.	Yes	4
CA1595X1/2-6	Isolator Mount	No	6
CHE-SRI-2	Grease, Std, Main Bearing/Conveyor, 14.5 Oz. Tube	Yes	12
CS10-RA-310-00	Support Bearing Inboard Seals	No	2
CS10-RA-311-00	Support Bearing Outboard Seals	No	2
CS10-RA-312-00	Thrust Bearing Seals	No	2
CS10-RA-316-00	O-Ring, Liquid Bowl Head	No	2
CS10-RA-321-00	O-Ring, Outer Liquid End	No	1
CS10-RA-322-00	O-Ring, Inner Liquid End	No	1
CS10-RA-323-00	O-Ring, Feed Accelerator	No	1
CS10-RA-324-00	O-Ring, Feed Nozzle	No	4
CS10-RA-325-00	O-Ring, Solid End	No	1
CS10-RA-510-00	Conveyor Thrust Bearing	No	2
CS10-RA-511-00	Conveyor Support Bearing	No	1
CS10-RA-512-00	Solid End Main Bearing	No	1
CS10-RA-513-00	Liquid End Main Bearing	No	1
CS10-RA-629-TC	Tungsten Feed Nozzle	Yes	4
CS10-RA-630-IC	Solid Discharge Wear Inserts (8 Pieces)	Yes	2 Sets
CS10-RA-634-IC	Case Plow	Yes	2 Pair
CS10-RA-650-IC	Bowl Head Plow	Yes	2 Pair
SHELL-OMALA320G	Oil, Gearbox	Yes	1
9537-00	Feed Accelerator	No	1
9540-00	Feed Tube	No	1
ORVI-ARP-242	O-Ring, Gear Flange	No	1
G0003211	O-Ring, Main Bearing, Outboard	No	2
G0003212	O-Ring, Main Bearing, Inboard	No	2

RECOMMENDED SPARE PARTS - DE-1000LP VFD CENTRIFUGE			
Part No.	**Description**	**Consumable**	**Qty**
Mechanical (Cont'd)			
G0008125	Coupling, Gearbox Pinion to Conveyor Motor	No	1
G0004365	Wave Spring, Conveyor Support Bearing	No	1
9524-00	Feed Nozzle Assembly	Yes	4
Electrical			
G0008359	Variable Frequency Drive, 50HP, Bowl Drive	No	1
G0007241	Variable Frequency Drive, 20HP, Conveyor Drive	No	1
G0008360	Variable Frequency Drive, 15HP, Pump Drive	No	1
G0004364	O-Ring, Protective Cover	No	1
15181-01-001	Protective Cover, Operator Control Panel (HMI)	No	1
G0008089	RTD Sensor, Solid End Bearing Temperature	No	1
G0008090	RTD Sensor, Liquid End Bearing Temperature	No	1
G0007861	Speed Sensor	No	1
G0007862	Cable, Speed Sensor	No	1
Control Cabinet			
G0008792	Fuse, 3A, Condenser Fan Motor	No	3
G0007583	Fuse, Cube Style, 100A, 600V, Bowl VFD	No	3
G0003484	Fuse, Cube Style, 40A, 600V, Pump VFD	No	3
G0002910	Fuse, Time Delay, 2.5A, 600Vac, Style CC	No	2
G0002911	Fuse, Time Delay, 7A, 250Vac, Style CC	No	1
G0002301	Air Filter Element, Type DX	Yes	1
G0002302	Air Filter Element, Type BX	Yes	1
G0008005	Door Latch	No	4
G0008349	PLC Battery	Yes	1
G0007228	PLC	No	1
G0009286	Intrinsic Safe Barrier, Vibration Switch	No	1

RECOMMENDED SPARE PARTS - DE-1000LP VFD CENTRIFUGE			
Part No.	**Description**	**Consumable**	**Qty**
G0007918	Intrinsic Safe Barrier, RTD Sensor	No	1
17244-01	Intrinsic Safe Barrier, Speed Sensor	No	1
G0003504	Surge Suppressor, 120V	No	1
17006-01	Mouse	No	1
G0007231	Ethernet Switch, 6 Port	No	1
G0008825	Operator Control Panel	No	1
G0009813	Air Conditioning Unit, 12,000 BTU	No	1
G0003552	Power Supply, 24Vdc, 5A	No	1
G0004195	Fuse, 0.5A	No	2
G0002926	Fuse, 1.25A	No	1
G0009286	Intrinsic Barrier, Purge System	No	1
G0003493	Fuse, 15A, Air Conditioner	No	3

TROUBLESHOOTING

Malfunctions due to operating error or other problem can result in unnecessary machine down-time and should be corrected as soon as possible. The troubleshooting procedures presented in this section will assist technicians in isolating and correcting malfunctions.

Fault analysis should proceed logically from the simplest cause to the more complex. The most difficult problem is an unexpected shutdown or inability to start. Always eliminate obvious causes of malfunction before proceeding to more complex possibilities. Since more than one cause may be responsible for a malfunction, the technician must proceed methodically to eliminate all possible causes and take all corrective actions at each step of the troubleshooting process.

In general, an unexpected centrifuge shutdown is due to an interruption of electric power that has turned off the bowl drive motor. Safety components are installed in key areas of the centrifuge electrical control system to shut down the electric motor if safety parameters such as motor temperature, vibration, or conveyor torque are exceeded. The power interruption may be due to one or more factors, including a local power failure.

In case of control system malfunction, with electric power shut down, locked out, and tagged out check that PLC connectors are fully seated in their receptacles. Correct as necessary before proceeding with further troubleshooting.

The troubleshooting chart consists of failure modes, possible cause(s), and recommended course(s) of action. All electrical continuity checks in this procedure are performed without electric power supplied to the centrifuge. Lock out and tag out equipment before attempting to perform any continuity check.

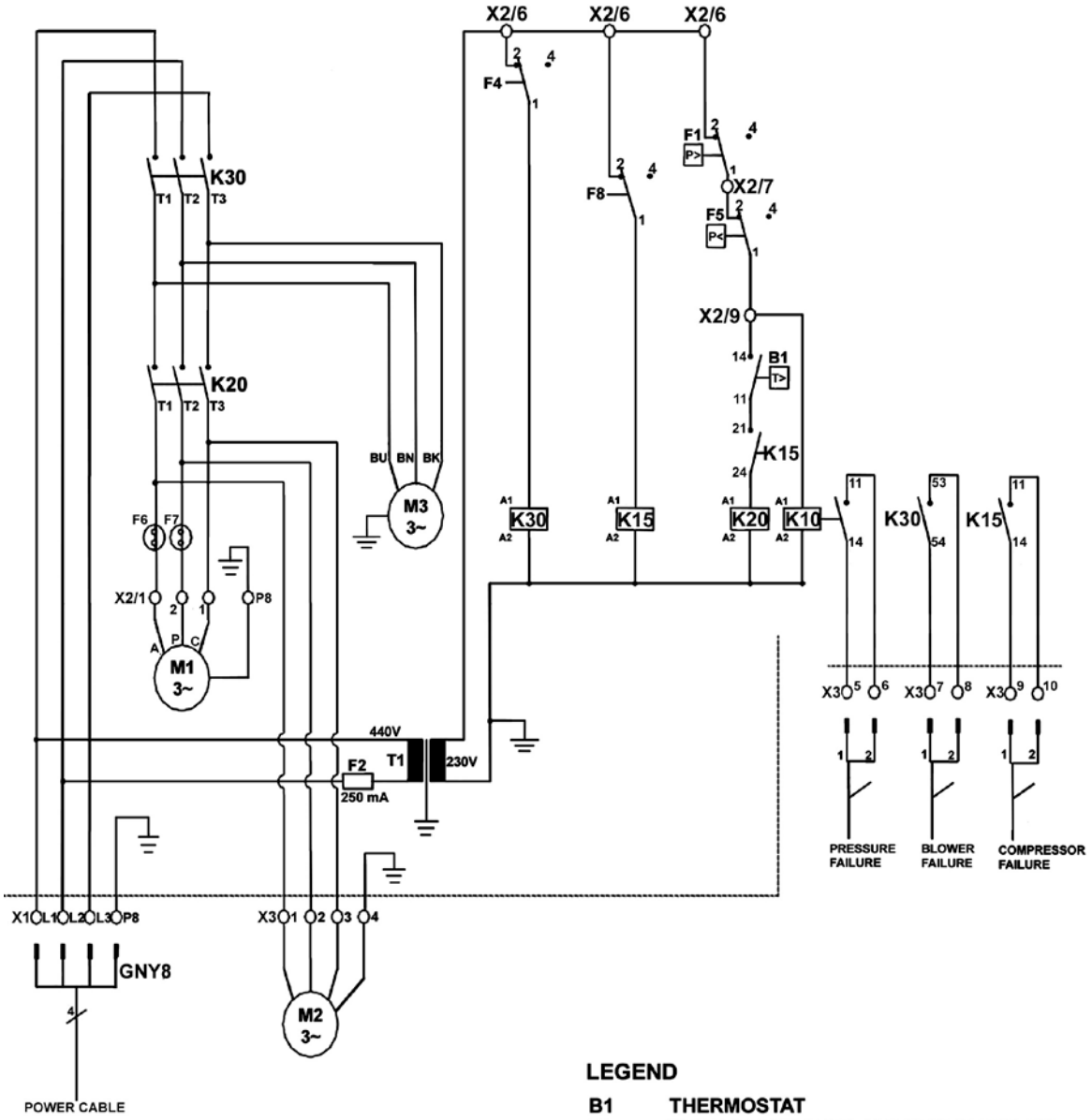
WARNING! CONTINUITY CHECKS MUST BE PERFORMED WITHOUT ELECTRIC POWER APPLIED TO CENTRIFUGE. LOCK OUT AND TAG OUT ELECTRIC POWER BEFORE ATTEMPTING CONTINUITY CHECKS.

TROUBLESHOOTING DE-1000LP VFD CENTRIFUGE	
Possible Cause	**Isolation Procedure & Corrective Action**
Failure Mode 1: Acceptable Liquid, Cake Too Thin	
Insufficient solids in feed	Increase feed rate.
	Increase weir opening (refer to Section 4).
	Reduce differential speed.
Drop in feed pump rate	Increase feed rate.
	Check feed pump; if required, check wear and replace worn parts.
	Check pump shaft seal, and correct any defects.
	Select RESET on Fault Reset screen to reset flow rate.
Failure Mode 2: Poor Liquid Quality, Acceptable Cake	
Differential speed too low	Increase differential speed.
	Increase differential speed and/or reduce quantity of solids in feed.
Excessive amount of solids in feed	Reduce quantity of solids in feed or add dilution stream if possible.
Change in feed characteristics	Reduce quantity of solids in feed or generally optimize machines settings, i.e. adjust bowl speed, differential speed, and weir opening.
Increase in solids wetness	Re-optimize machine settings.
	Reduce feed rate.
	Increase weir opening (refer to Section 4).
	Reduce differential speed.
	Reduce weir opening if improved liquid is desired.
Conveyor flights worn excessively.	Inspect flights through the solid discharge outlets. If damage is evident, remove and disassemble bowl, and inspect conveyor flights carefully (refer to *Rotating Assembly Maintenance*). Repair or replace conveyor, if required.

TROUBLESHOOTING DE-1000LP VFD CENTRIFUGE	
Possible Cause	**Isolation Procedure & Corrective Action**
Failure Mode 3: Excessive Vibration	
Bowl assembly unbalanced due to uneven mechanical wear, worn parts, or deformed conveyor flights	Remove and disassemble bowl, and inspect conveyor flights (refer to *Rotating Assembly Maintenance*). Repair or replace conveyor, if required.
Conveyor bearing defective due to inadequate lubrication, product entry past seal, or normal wear	Remove and disassemble bowl, and inspect conveyor bearing (refer to *Conveyor Bearing Replacement)*. Replace conveyor bearings.
Bowl assembly main bearings defective.	Remove rotating assembly, and replace both bearings (refer to *Main Bearing Replacement*).
Excessive buildup of solids in bowl and/or conveyor.	Perform cleanout procedure (refer to Section 4).
Failure Mode 4: No Liquid Discharge, Untreated Feed Material Exits Liquid Discharge Outlet	
Buildup of solids between flights; solids not being transported to discharge but are discharged with liquid	Shut down feed pump and bowl assembly drive motor, but keep conveyor motor running and admit rinse water into machine. If solids emerge before bowl fully stops, re-start centrifuge.
	Shut down, lock out, and tag out electric power. Open top cover, and insert hose into liquid and solids discharge openings and flush bowl interior with water (preferably hot water).
	If flushing is unsuccessful in clearing the blockage, remove rotating assembly and remove conveyor to facilitate thorough cleaning. (refer to *Rotating Assembly Maintenance*).
Failure Mode 5: High Power Consumption, Machine Clogged	
Solids accumulated within case	Open top cover, and thoroughly clean case interior, bowl exterior, and solids discharge chute.
Failure Mode 6: Machine Clogged Upon Starting After a Brief Shutdown	
Excessive solids volume in feed due to sedimentation in supply line	Perform cleanout procedure (refer to Section 4).
	Prevent future repetition by clearing feed line immediately after shutting down machine.
Failure Mode 7: Machine Shutdown Due to Excessive Power Consumption During Startup	
Discharge chute clogged	Clear discharge chute of all accumulated solids.

TROUBLESHOOTING DE-1000LP VFD CENTRIFUGE	
Possible Cause	**Isolation Procedure & Corrective Action**
Failure Mode 8: Excessively High Main Bearing Temperature	
Insufficient lubrication	Lubricate bearings (refer to *Preventive Maintenance*).
Excessive grease	Remove grease fitting, and direct jet of filtered compressed air to remove grease.
Incorrect grease	Lubricate with recommended grease (refer to *Preventive Maintenance*).
Defective bearing	Replace both main bearings (refer to *Main Bearing Replacement*).
Failure Mode 9: Purge System Purges Correctly, But Alarm Goes On At End Of Purge Interval And Purge Cycle Is Repeated	
Actual cabinet pressure below setting of minimum pressure sensor.	Check cabinet pressure with a Magnahelic gage. Adjust minimum pressure sensor to correspond with actual cabinet pressure.
Leakage compensation valve setting to low, causing re-purge to occur.	Increase cabinet pressure by turning leakage compensation valve adjustment counterclockwise. Contact Derrick for assistance if problem is not corrected.
Failure Mode 10: Purging Indicator Does Not Become Amber During Purging	
Low air pressure.	Check that air supply line is at least 3/4” (19mm). Replace line if undersize.
	Check for stable air pressure of 60-115psi (4-8barg). Adjust air pressure if low.
Excessive leakage from cabinet.	Check for leakage at cabinet door gasket and at all potential sources of leakage. Maximum permissible leakage is 2.5cfm. Correct as required.
Tube between relief valve and flow sensor not air tight.	Check that coupling nuts are tight and tube is undamaged. Correct as required.
Purge flow sensor out of calibration or defective.	Unscrew diaphragm housing from sensor and, using a suitable plug, close off 12mm threaded opening in top of valve module. Turn on system , and check purge indicator color. If indicator becomes amber, re-calibrate or replace sensor diaphragm. Contact Derrick for assistance if color change does not occur.
Failure Mode 11: Purge System Fails To Turn On Power After Purge Time Has Elapsed	
No power to system.	Check and correct power loss.
Main power contactor turned off.	Switch on contactor.
Blown fuse.	Check and replace fuse(s) if blown.

TROUBLESHOOTING DE-1000LP VFD CENTRIFUGE	
Possible Cause	**Isolation Procedure & Corrective Action**
Failure Mode 11: Purge System Fails To Turn On Power After Purge Time Has Elapsed (Cont'd)	
Purge cycle not completed.	Press indicator button on timer valve. If purge time has been completed, indicator button will return when released. If button does not return, allow additional time for cycle to complete.
Low or no pressure at power switch output bulkhead and/or at power switch.	Check and adjust pressure if low.
Tubing to power switch leaking.	Check that coupling nuts are tight and that tubing is not damaged. Correct any defects.
Defective power switch.	Check that power switch contacts close at 20 psi (1.4 barg). Replace switch if contacts fail to close.
Incorrect purge time.	Check timer setting, and reset to minimum available purge time. Re-check system operation at new setting. If system functions properly, return purge time to original setting. If system fails to close switch, contact Derrick for assistance.
Failure Mode 12: Purge System Relief Valve Remains Open Or Opens Intermittently	
Leakage compensation valve out of adjustment causing high cabinet pressure.	Adjust leakage compensation valve by turning adjustment clockwise to reduce pressure.
Debris on relief valve disk, allowing air leakage.	Remove relief valve cover, and clean valve disk as required. If necessary to remove disk and spring from relief valve, mark location of disk before removal to ensure proper installation. If cleaning disk fails to eliminate problem, contact Derrick for assistance.
Failure Mode 13: Air Conditioner Evaporator Faan Fails to Go On	
Poor electrical connection	Shut down, lock out, and tag out electric power to centrifuge. Open control cabinet door, and locate fan at upper right. Remove 8 screws securing fan to air conditioner housing, and separate fan from housing. While supporting fan, check that fan plugs are securely connected and that all leads are secure in connectors. Correct as required; continue trouble shooting if leads are secure.
Fan motor bearings binding or seized.	With fan separated from air conditioner housing, unplug and remove fan. Check that fan rotates freely and no rubbing is detected. Replace fan if rubbing or binding is found.
High temperature switch motor winding defective	Using an ohmmeter, check for continuity across 2 light gray motor leads of fan connector (Figure 5-14 through 5-17). If meter indicates an open circuit, verify that leads are securely connected; correct as needed. If connections are secure, replace fan.



LEGEND

B1	THERMOSTAT
F1	HIGH REFRIGERANT PRESSURE SWITCH
F2	FUSE
F4	M3 THERMAL PROTECTOR CONTACT
F5	LOW REFRIGERANT PRESSURE SWITCH
F6/F7	M1 THERMAL PROTECTORS
F8	M1 THERMAL PROTECTOR CONTACTS
K10	FAULT SIGNAL RELAY
K15	M1 THERMAL PROTECTOR RELAY
K20	COMPRESSOR CONTACTOR
K30	POWER CONTACTOR
M1	COMPRESSOR
M2	CONDENSER FAN
M3	EVAPORATOR FAN
T1	CONTROL TRANSFORMER
X1-X3	TERMINAL BOARD

Figure 5-14. Air Conditioner Electrical Schematic Diagram

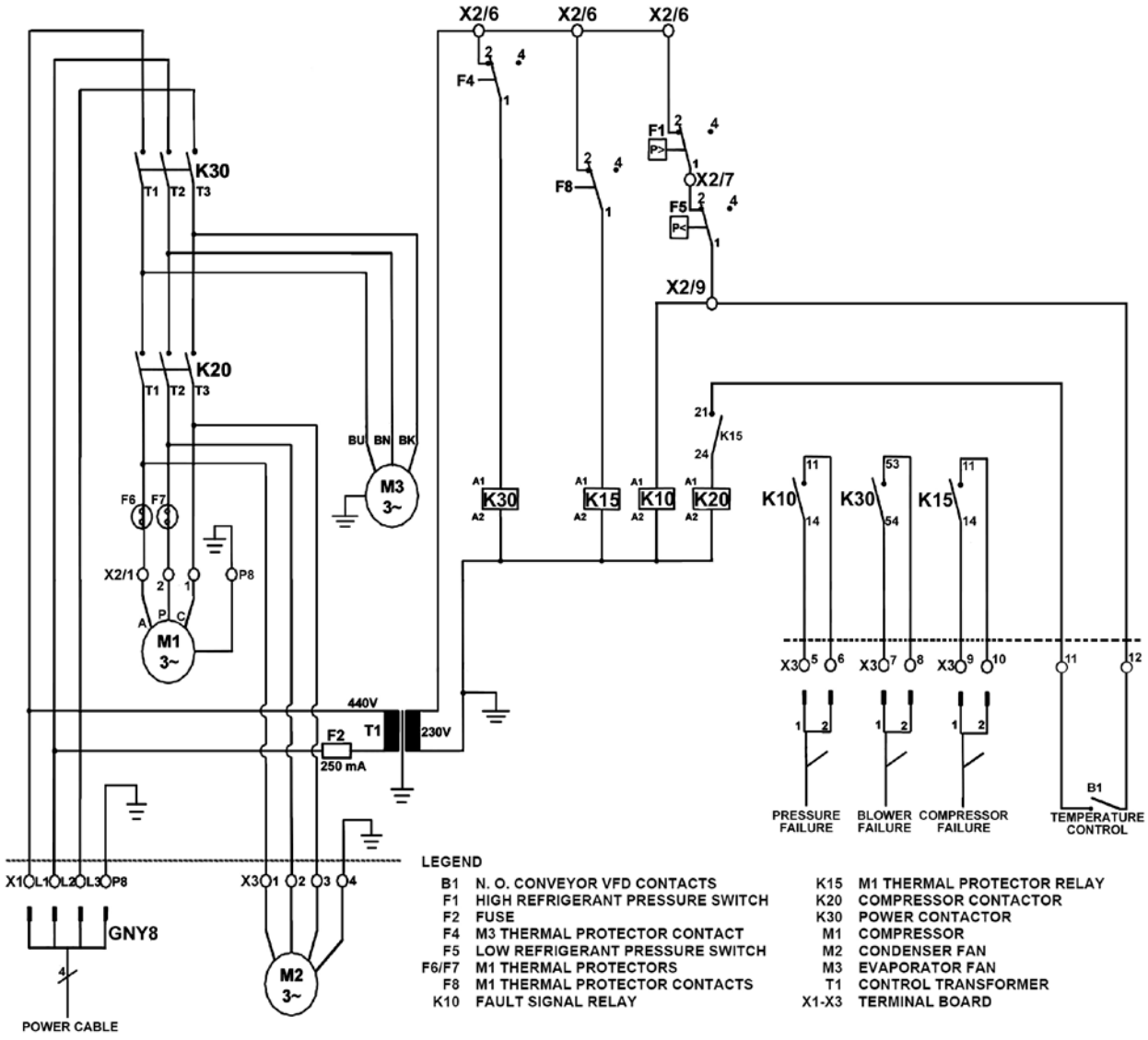


Figure 5-15. Air Conditioner Electrical Schematic Diagram - 230Vac RTD Sensing

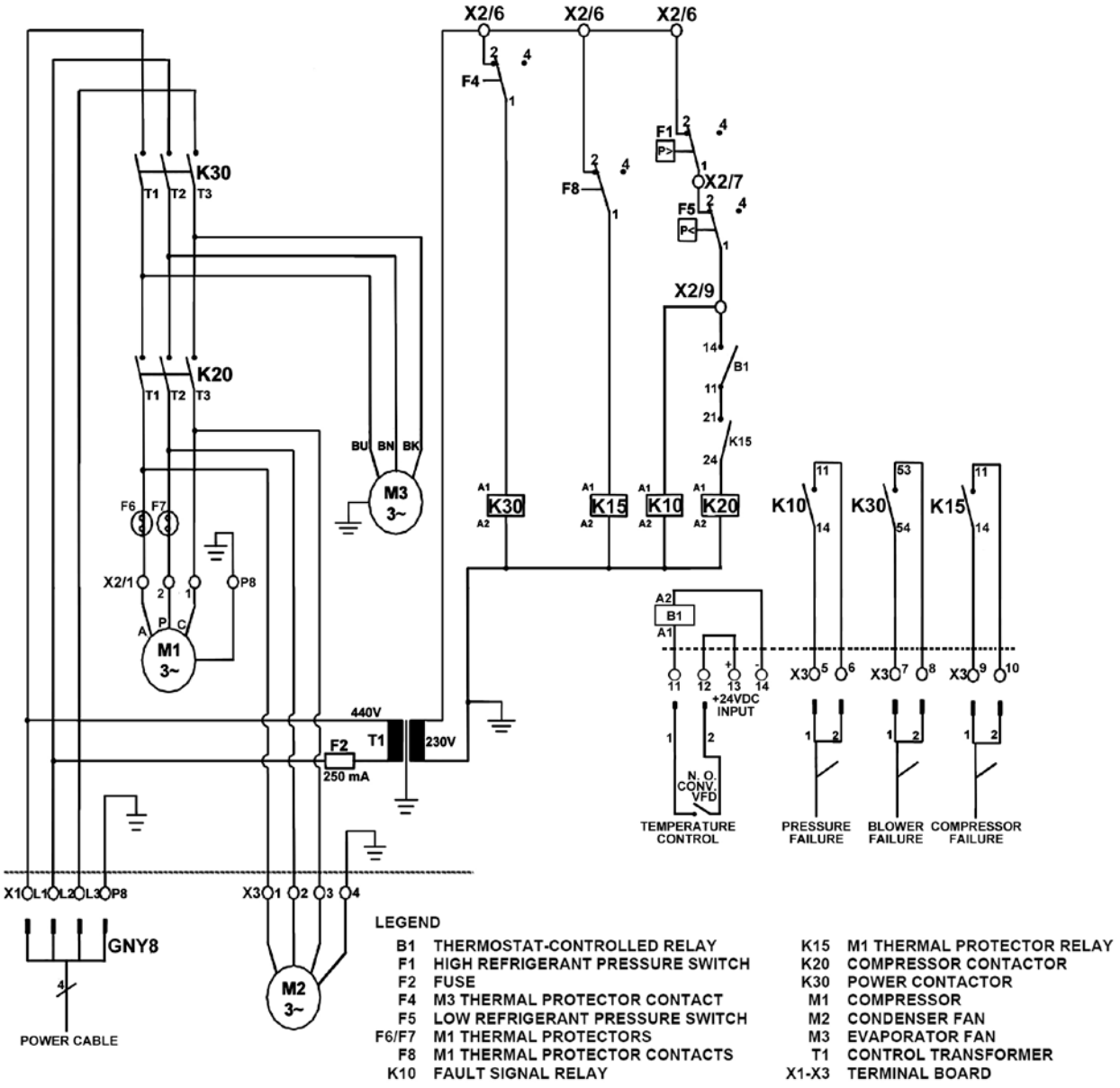


Figure 5-16. Air Conditioner Electrical Schematic Diagram - 24Vdc RTD Sensing

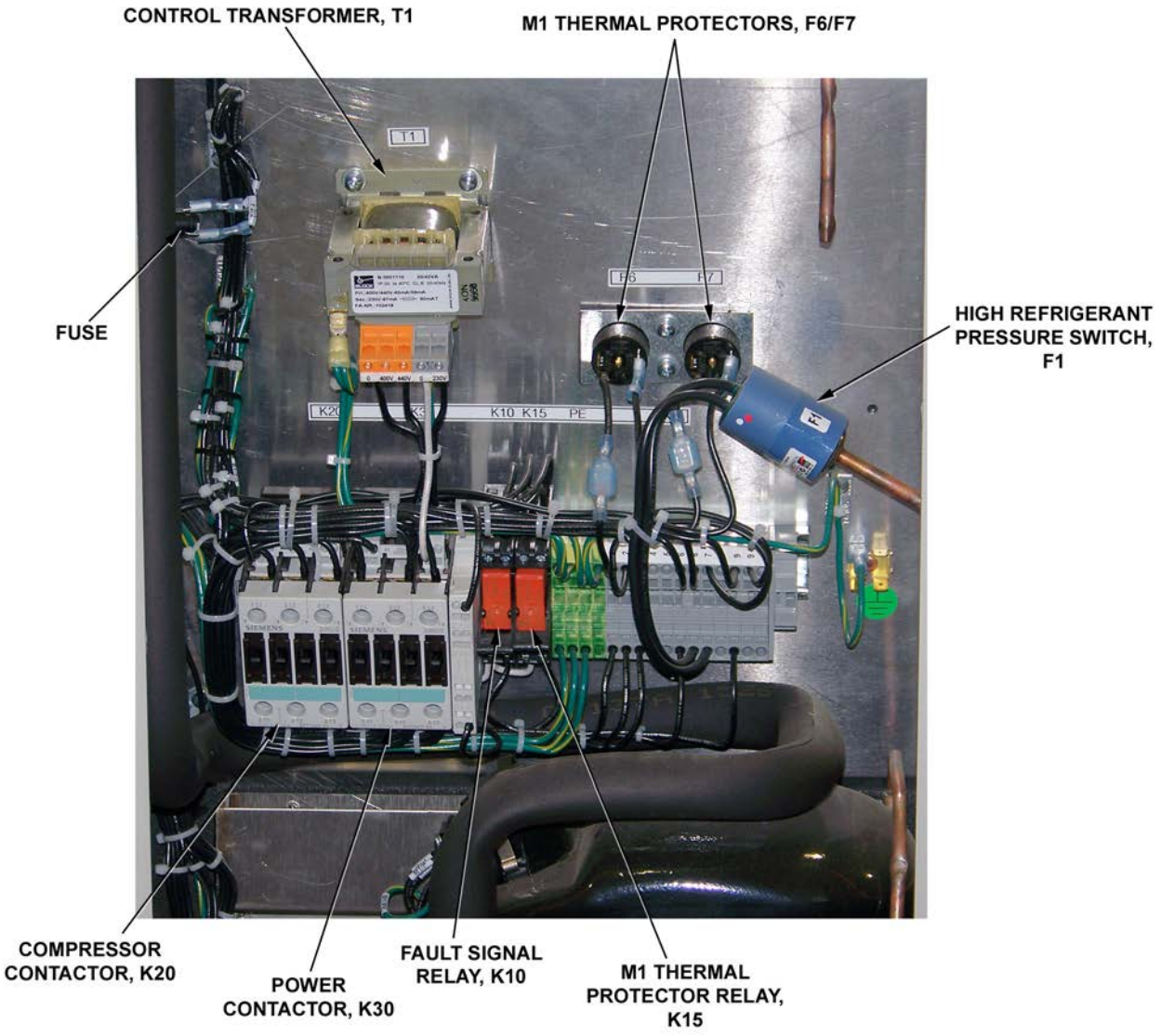


Figure 5-17. Air Conditioner Electrical Components

ALARM AND FAULT MESSAGES

Intervention is required if a message appears to alert the operator to an anomaly that has occurred. Alarm messages signify that the prevailing condition must be corrected or the centrifuge may be shut down automatically. Fault messages inform the operator that a failure requiring automatic shutdown has occurred.

Refer to the following table for alarm and fault messages and their causes and corrective actions for assistance in analyzing messages.

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F1000 - Bowl Exceeded Maximum Speed, Shutdown	
Incorrect or loose connection at speed sensor or defective speed sensor	Check speed sensor connection (refer to Section 3). Replace sensor if defective.
Bowl VFD malfunction	If problem persists, contact Derrick Service for assistance.
F1001 - Bowl High Torque Alarm, Reduce Feed Rate	
Bowl torque exceeds pre-set limit	Reduce feed rate and/or reduce bowl speed.
F1002 - Bowl High Torque Fault and Shutdown, Perform Cleanout and Reduce Feed Rate	
Bowl torque exceeds pre-set limit	After bowl has stopped rotating, perform cleanout procedure to remove solids buildup, and re-start centrifuge at reduced feed rate.
F1010 - Bowl VFD Communications Error	
Communication lost between bowl VFD and PLC	Confirm that green LED next to Ethernet cable on Ethernet switch is lighted, indicating that hub is functional.
	Check connections between bowl VFD and PLC, and correct any defects.
	Replace bowl VFD communication module, if no other defect is found.
F1011 - Bowl VFD Alarm, Ref Troubleshooting Section of User Manual	
Bowl VFD alarm	Identify alarm from operator control panel. Perform indicated corrective action.
F1012 - Bowl VFD Fault and Shutdown, Ref Troubleshooting Section of User Manual	
Bowl VFD fault	Identify fault from operator control panel. Perform indicated corrective action.
F1013 - Bowl VFD Ground Warn Alarm, Ref Troubleshooting Section of User Manual	
Bowl VFD has detected high current leakage to ground	Check condition of cable and all connections between bowl VFD and bowl motor, and correct any defects.
F1014 - Bowl VFD In Phase Loss Alarm, Ref Troubleshooting Section of User Manual	
Bowl VFD has detected unbalance or partial loss of input three-phase power	Check wiring between VFD and supply source; correct defect(s).
	Check supply power, and correct any defects.
F1015 - Bowl VFD Power Loss Alarm, Ref Troubleshooting Section of User Manual	
Incoming power loss or low voltage supply	Check incoming power and correct any defect(s).

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F1016 - Bowl VFD Undervoltage Alarm, Ref Troubleshooting Section of User Manual	
Incoming power loss or low voltage supply	Check incoming power and correct any defect(s).
F1017 - Bowl VFD Drive OL Alarm, Ref Troubleshooting Section of User Manual	
Feed rate causing overload	Reduce feed rate or reduce bowl speed.
Bowl drive motor drawing excessive current	Replace motor if defective.
F1021 - Bowl Motor Thermal Overload Check Bowl Motor Temperature and Thermistor	
Bowl drive motor shut down due to high temperature or defective thermistor in motor winding	Check motor temperature. Allow motor to cool, and then check for continuity across thermistor leads. If open circuit is found, replace motor.
Bad connection(s)	Check connections at TB2-7 and 8, at transmitter/intrinsic barrier, and at conveyor VFD. Correct as required. Replace motor if no defects are found.
F2001 - Conveyor High Torque Alarm, Reduce Feed Rate	
Conveyor torque exceeds pre-set limit	Reduce feed rate and/or increase differential speed.
F2002 - Conveyor High Torque Fault and Shutdown, Perform Cleanout and Reduce Feed Rate	
Conveyor torque exceeds pre-set limit	After bowl has stopped rotating, perform cleanout procedure to remove solids buildup, and re-start centrifuge at reduced feed rate and/or higher differential speed.
F2010 - Conveyor VFD Communications Error	
Communication lost between conveyor VFD and PLC	Confirm that green LED next to Ethernet cable on Ethernet switch is lighted, indicating that hub is functional.
	Check connections between conveyor VFD and PLC, and correct any defects.
	Replace conveyor VFD communication module, if no other defect is found.
F2011 - Conveyor VFD Alarm, Ref Troubleshooting Section of User Manual	
Conveyor VFD alarm	Identify alarm from operator control panel. Perform indicated corrective action.

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F2012 - Conveyor VFD Fault and Shutdown, Ref Troubleshooting Section of User Manual	
Conveyor VFD fault	Identify fault from operator control panel. Perform indicated corrective action.
F2013 - Conveyor VFD Ground Warn Alarm, Ref Troubleshooting Section of User Manual	
Conveyor VFD has detected high current leakage to ground	Check condition of cable and all connections between conveyor VFD and conveyor motor, and correct any defects.
F2014 - Conveyor VFD In Phase Loss Alarm, Ref Troubleshooting Section of User Manual	
Conveyor VFD has detected unbalance or partial loss of input three-phase power	Check wiring between VFD and supply source; correct defect(s).
	Check supply power, and correct any defects.
F2015 - Conveyor VFD Power Loss Alarm, Ref Troubleshooting Section of User Manual	
Incoming power loss or low voltage supply	Check incoming power, and correct any defect(s).
F2016 - Conveyor VFD Undervoltage Alarm, Ref Troubleshooting Section of User Manual	
Incoming power loss or low voltage supply	Check incoming power, and correct any defect(s).
F2021 - Conveyor Motor Thermal Overload Check Conveyor Motor Temperature and Thermistor	
Conveyor drive motor shut down due to high temperature or defective thermistor in motor winding	Check motor temperature. Allow motor to cool, and then check for continuity across thermistor leads. If open circuit is found, replace motor.
Bad connection(s)	Check connections at TB2-5 and 6, at transmitter/intrinsic barrier, and at conveyor VFD. Correct as required. Replace motor if no defects are found.
F3001 - Pump Shutdown or Will Not Start Due to Dry Run Protection Alarm	
Low tank level	Check and re-fill feed tank sufficiently to close low level switch.
F3002 - Flow Meter Flow Detection Error, Feed Pump has Shutdown	
Insufficient pump output detected	Check and re-fill feed tank sufficiently. Verify that control valves (if any) are open to allow material to flow.

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F3010 - Pump VFD Communications Error	
Communication lost between pump VFD and PLC	Confirm that green LED next to Ethernet cable on Ethernet switch is lighted, indicating that hub is functional.
	Check connections between pump VFD and PLC, and correct any defects.
	Replace pump VFD, if no other defect is found.
F3011 - Pump VFD Alarm, Ref Troubleshooting Section of User Manual	
Pump VFD alarm	Identify alarm from operator control panel. Perform indicated corrective action.
F3012 - Pump VFD Fault, Ref Troubleshooting Section of User Manual	
Pump VFD fault	Identify fault from operator control panel. Perform indicated corrective action.
F3013 - Pump VFD Ground Warn Alarm, Ref Troubleshooting Section of User Manual	
Pump VFD has detected high current leakage to ground	Check condition of cable and all connections between pump VFD and pump motor, and correct any defects.
F3014 - Pump VFD In Phase Loss Alarm, Ref Troubleshooting Section of User Manual	
Pump VFD has detected unbalance or partial loss of input three-phase power	Check wiring between VFD and supply source; correct defect(s).
	Check supply power, and correct any defects.
F3015 - Pump VFD Power Loss Alarm, Ref Troubleshooting Section of User Manual	
Incoming power loss or low voltage supply	Check incoming power and correct any defect(s).
F3016 - Pump VFD Undervoltage Alarm, Ref Troubleshooting Section of User Manual	
Incoming power loss or low voltage supply	Check incoming power and correct any defect(s).
F3017 - Pump VFD Drive OL Alarm, Ref Troubleshooting Section of User Manual	
Pump drive motor drawing excessive current	Replace motor, if defective, or remove other cause of excessive current draw. Perform autotune of pump motor/drive.

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F3021 - Pump Motor Thermal Overload Check Pump Motor Temperature and Thermistor	
Pump drive motor shut down due to high temperature or defective thermistor in motor winding	Check motor temperature. Allow motor to cool, and then check for continuity across thermistor leads. If open circuit is found, replace motor.
Bad connection(s)	Check connections at TB2-3 and 4, at transmitter/intrinsic barrier, and at pump VFD. Correct as required. Replace motor if no defects are found.
F3022 - Pump Bearing/Stator Thermal Overload Check Pump Bearing Temperature and Stator	
Pump drive motor shut down due to high bearing temperature or high temperature in stator winding	Check motor bearing temperature. Allow motor to cool, and then check for continuity across stator thermistor leads. If open circuit is found, replace motor.
Bad connection(s)	Check connections at TB2-3 and 4, at transmitter/intrinsic barrier, and at pump VFD. Correct as required. Replace motor if no defects are found.
F3030 - Pump Motor FLA Download to VFD Failed	
Pump motor FLA download was not successfully completed	Repeat pump motor data download procedure. Verify that pump drive is on line and stopped.
F3031 - Pump Motor Power Download to VFD Failed	
Pump motor power download was not successfully completed	Repeat pump motor data download procedure. Verify that pump drive is on line and stopped.
F3032 - Pump Motor Power Units Download to VFD Failed	
Pump motor power units download was not successfully completed	Repeat pump motor data download procedure. Verify that pump drive is on line and stopped.
F4001 - Centrifuge Start Disable - Allow Bowl to Stop Completely, View Alarm History for Additional Fault Conditions	
Restart aborted due to bowl rotation during restart attempt	Wait for bowl to fully stop, check for and clear all faults, and verify that bowl is at complete standstill. Restart centrifuge.
F4002 - Clean Out Over Torque Fault	
Excessive torque has caused clean out procedure to abort	Attempt to clear using Manual Cleanout procedure in this section. If unsuccessful, connect a liquid supply line to flush fitting to dilute process material, and re-attempt Manual Cleanout. If still unsuccessful, with bowl at complete standstill, open cover and remove excessive process material.

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F4003 - Liquid End Main Bearing High Temperature Alarm	
Incorrect or loose connection at temperature sensor	If reading is constantly about 392°F (200°C), check and correct connection (refer to Section 3 and electrical schematic diagram in Section 8).
Insufficient bearing lubrication	Lubricate bearings (refer to *Preventive Maintenance*).
Excess grease	Remove grease fitting, and direct jet of filtered compressed air into opening to remove grease.
Incorrect grease	Lubricate with recommended grease (refer to *Preventive Maintenance*).
Defective bearing	Contact Derrick Service department for assistance.
F4004 - Liquid End Main Bearing High Temperature Fault and Shutdown	
Insufficient bearing lubrication	Lubricate bearings (refer to *Preventive Maintenance*).
Excess grease	Remove grease fitting, and direct jet of filtered compressed air into opening to remove grease.
Incorrect grease	Lubricate with recommended grease (refer to *Preventive Maintenance*).
Defective bearing	Contact Derrick Service department for assistance.
F4005 - Solid End Main Bearing High Temperature Alarm	
Incorrect or loose connection at temperature sensor	If reading is constantly about 392°F (200°C), check and correct connection (refer to electrical schematic diagram in Section 8).
Insufficient bearing lubrication	Lubricate bearings (refer to *Preventive Maintenance*).
Excess grease	Remove grease fitting, and direct jet of filtered compressed air into opening to remove grease.
Incorrect grease	Lubricate with recommended grease (refer to *Preventive Maintenance*).
Defective bearing	Replace rotating assembly (refer to *Rotating Assembly Maintenance*).

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F4006 - Solid End Main Bearing High Temperature Fault and Shutdown	
Insufficient bearing lubrication	Lubricate bearings (refer to *Preventive Maintenance*).
Excess grease	Remove grease fitting, and direct jet of filtered compressed air into opening to remove grease.
Incorrect grease	Lubricate with recommended grease (refer to *Preventive Maintenance*).
Defective bearing	Contact Derrick Service department for assistance.
F7011 - Air Conditioner Compressor Motor Overload Fault	
Motor drawing excessive current	Confirm proper operation of relays K20 and K30 and adequacy of three-phase power supply. Check all electrical connections. Correct any defects.
F7012 - Air Conditioner Internal Fan Motor Overload Fault	
Motor drawing excessive current	Confirm proper operation of relays K20 and K30 and adequacy of three-phase power supply. Check all electrical connections. Correct any defects.
F7013 - Air Conditioner Refrigerant Pressure High or Low Fault	
Refrigerant pressure high or low	Attempt to re-start centrifuge. Low pressure will cause immediate shutdown or failure to start; high pressure will permit brief operation and then automatic shutdown. If low pressure indicated, contact Derrick Service for assistance. If high pressure indicated, continue troubleshooting.
Condenser motor rotation incorrect or motor defective	Check rotation direction, and reverse, if necessary, by switching two leads.
Condenser cooling fins clogged	Use vacuum cleaner to remove all debris from fins.
Condenser motor defective	Check motor, and replace if defective. If problem persists, contact Derrick Service for assistance.
F7021 - Electrical Enclosure High Temperature Alarm	
Control cabinet interior temperature has exceeded alarm setpoint	Check status/operation of air conditioner; repair or replace if defective.
	Reduce load by decreasing bowl, conveyor differential speed, and/or pump feed rate.

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F7022 - Electrical Enclosure High Temperature Fault and Shutdown	
Control cabinet interior temperature has exceeded alarm setpoint	Check status/operation of air conditioner; repair or replace if defective.
	Reduce load by decreasing bowl, conveyor differential speed, and/or pump feed rate.
Interior temperature of control cabinet too high, causing shutdown	Check that air conditioner is operating; repair or replace, as indicated. Inspect cabinet interior, and remove cause of high temperature, if any. Re-start centrifuge after removing cause of high temperature.
F7031 - Enclosure Temperature Sensor Error	
Control cabinet interior temperature sensor not functioning	Check sensor and connection. Correct any wiring defects, and replace sensor if defective.
F8001 - Emergency Stop Switch Activated, Shutdown	
EMERGENCY STOP initiated	Remove cause for emergency stop, pull out EMERGENCY STOP, and then re-start centrifuge.
F8002 - Emergency Stop Switch or Belt Guard Sensor Trip	
EMERGENCY STOP initiated or belt guard removed or not secure	Check and secure belt guard, pull out EMERGENCY STOP, and then re-start centrifuge.
F8003 - High Vibration Fault and Shutdown, Correct Problem and Press Reset Button	
Rotating assembly unbalanced or mechanical looseness	Rotating assembly overloaded or clogged, bearing failure, conveyor wear, or loose pillow block bolts producing out-of-balance condition. Remove cause of excessive vibration and re-start centrifuge.
F8004 - High Vibration Switch or Bowl Cover Sensor Trip	
Case cover not secure	Check and secure cover, and re-start centrifuge.
Rotating assembly unbalanced or mechanical looseness	Rotating assembly overloaded or clogged, bearing failure, conveyor wear, or loose pillow block bolts producing out-of-balance condition. Remove cause of excessive vibration and re-start centrifuge.
F9010 - Control Program Downloaded from Memory Card to Controller	
Re-loading of PLC program from memory card completed	Start centrifuge, and resume operation.
F9011 - Controller Internal Battery Low, Replace	
PLC battery low	Replace battery.

ALARM AND FAULT MESSAGES	
Cause	**Corrective Action**
F9012 - External Communication Loss, Switched to Local Control	
Profibus not working, remote control is disabled and control has automatically switched to local	Check and correct any defects in Profibus connections, and attempt to re-start in Remote operating mode.
F9021 - Signal Loss - Bowl Speed Sensor Intrinsic Barrier	
Minimum analog signal from transmitter/intrinsic barrier not received by PLC	Check all connections at transmitter/intrinsic barrier; replace transmitter if all connections are secure.
F9022 - Signal Loss - Bowl Speed Sensor or Cable	
Incorrect or loose connection at speed sensor or defective speed sensor	Check sensor connections; replace sensor if defective.
Defective speed sensor transmitter/intrinsic barrier	Check and replace transmitter/intrinsic barrier, if defective.
Pump VFD fault	Identify fault from operator control panel. Perform indicated corrective action.
F9032 - Signal Loss - Bowl Speed Sensor or Cable	
Incorrect or loose connection at speed sensor or defective speed sensor	Check sensor connections; replace sensor if defective.
Defective speed sensor transmitter/intrinsic barrier	Check and replace transmitter/intrinsic barrier, if defective.
Pump VFD fault	Identify fault from operator control panel. Perform indicated corrective action.
F9041 - Signal Loss - Liquid End Bearing Temp Intrinsic Barrier	
Minimum analog signal from transmitter/intrinsic barrier not received by PLC	Check all connections at transmitter/intrinsic barrier; replace transmitter if all connections are secure.
F9051 - Signal Loss - Solid End Bearing Temp Intrinsic Barrier	
Minimum analog signal from transmitter/intrinsic barrier not received by PLC	Check all connections at transmitter/intrinsic barrier; replace transmitter if all connections are secure.
F9099 - Centrifuge Sensor I/O Cable Has Been Removed, Reconnect I/O Cable to Run Centrifuge	
Sensor cable is disconnected from control cabinet receptacle	Plug in connector at upper left of cabinet, and then re-start centrifuge.

VFD ALARM AND FAULT CROSS REFERENCES

In addition to alarm and fault messages that may appear on the operator control panel, in case of equipment malfunction alarm and fault numbers may appear directly on the VFD screens. An alarm is a condition that, if neglected, may stop the drive. A fault is a condition that stops the drive.

The following tables list these alarm and fault numbers and the corresponding text. This information is useful for operators and Derrick personnel to diagnose equipment malfunctions. To expedite troubleshooting, record the code number before calling for service and then relay this information to the service engineer.

ALARM CROSS REFERENCE					
No.	**Alarm**	**No.**	**Alarm**	**No.**	**Alarm**
1	Precharge Active	14	Load Loss	27	Speed Ref Cflct
2	UnderVoltage	15	Ground Warn	28	Ixo Vlt Rang
3	Power Loss	17	Dig In ConflictA	29	Sleep Config
4	Start At PowerUp	18	Dig In ConflictB	30	TB Man Ref Cflct
5	Analog In Loss	19	Dig In ConflictC	31	PTC Conflict
6	IntDBRes OvrHeat	20	BiPolar Conflict	32	Brake Slipped
8	Drive OL Level 1	21	Motor Type Cflct	33	AdjVoltRef Cflct
9	Drive OL Level 1	22	NP Hz Conflict	34	Home Not Set
10	Decel Inhibt	23	MaxFreq Conflict	49	Torq Prove Cflct
11	Waking	24	VHz Neg Slope	50	Prof Step Cflct
12	Motor Thermistor	25	IR Volts Range	52	PI Config Cflct
13	In Phase Loss	26	FluxAmpsRef Rang		

FAULT CROSS REFERENCE					
No.	**Fault**	**No.**	**Fault**	**No.**	**Fault**
2	Auxiliary Input	38	Phase U to Grnd	81-85	Port 1-5 DPI Loss
3	Power Loss	39	Phase V to Grnd	87	IXo VoltageRange
4	UnderVoltage	40	Phase W to Grnd	88	Software Fault
5	OverVoltage	41	Phase UV Short	89	Software Fault
7	Motor Overload	42	Phase VW Short	90	Encoder Quad Err
8	Heatsink OvrTemp	43	Phase UW Short	91	Encoder Loss
9	Trnsistr OvrTemp	48	Params Defaulted	92	Pulse In Loss
12	HW OverCurrent	49	Drive Powerup	93	Hardware Fault
13	Ground Fault	51	Flt QueueCleared	100	Parameter Chksum
15	Load Loss	52	Faults Cleared	101-103	UserSet Chksum
16	Motor Thermistor	55	Cntl Bd Overtemp	104	Pwr Brd Chksum1
17	Input Phase Loss	63	Shear Pin	105	Pwr Brd Chksum2

FAULT CROSS REFERENCE					
No.	**Fault**	**No.**	**Fault**	**No.**	**Fault**
20	TorqProv Spd Band	64	Drive OverLoad	106	Incompat MCB-PB
21	Output PhaseLoss	69	DP Resistance	107	Replaced MCB-PB
24	Decel Inhibit	70	Power Unit	108	Anlg Cal Chksum
25	OverSpeed Limit	71-75	Port 1-5 Adapter	120	I/O Mismatch
28	See Manual	77	IR Volts Range	121	I/O Comm Loss
29	Analog In Loss	78	FluxAmpsRef Rang	122	I/O Failure
33	Auto Rstrt Tries	79	Excessive Load	130	Hardware Fault
36	SW OverCurrent	80	AutoTune Aborted	131	Hardware Fault

CONTROL COMPONENT INDICATORS

Various indicators are provided to display the operational status of components in the control cabinet. Figures 5-18 through 5-21 locate and define the indications shown on these components. Where applicable, corrective actions are included to assist the operator in fault analysis.

Dangerously high voltage is present in the control cabinet. Since opening the control cabinet door and bypassing the cabinet purge system is required to check the indicators, only trained, qualified personnel should be permitted to perform these procedures. Use extreme caution to ensure that the surrounding atmosphere is free of hazardous fumes before opening the cabinet door and bypassing the purge system.

DANGER! HIGH VOLTAGE! SHUT DOWN, LOCK OUT, AND TAG OUT ELECTRIC POWER, AND ENSURE THAT EQUIPMENT HAS STOPPED ROTATING BEFORE WORKING ON THIS EQUIPMENT.

WARNING! HAZARDOUS GASES CAN CAUSE EXPLOSION. BE CERTAIN THAT SURROUNDING ATMOSPHERE IS CLEAR OF ALL POTENTIALLY EXPLOSIVE GASES BEFORE OPENING CONTROL CABINET DOOR.

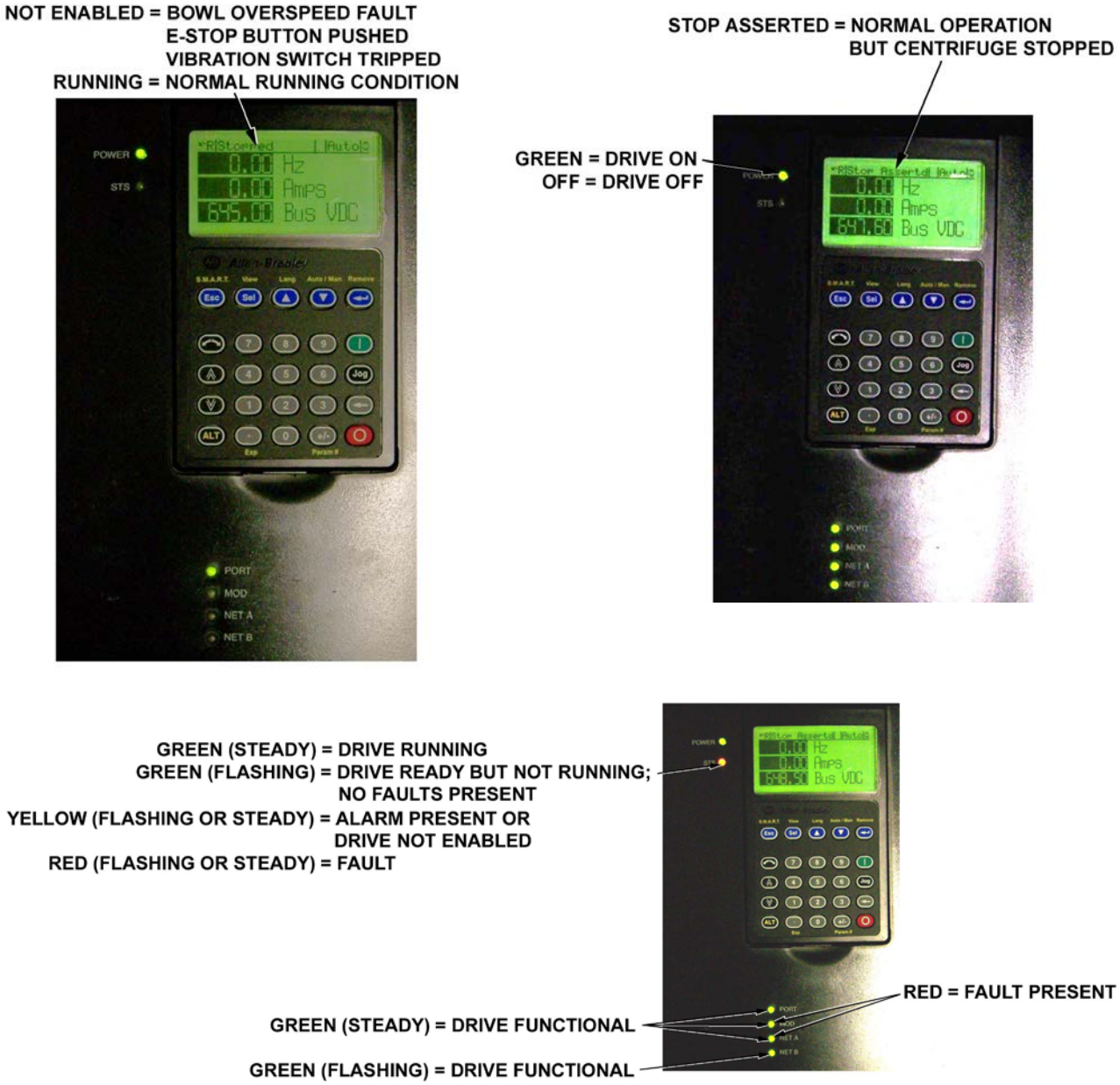
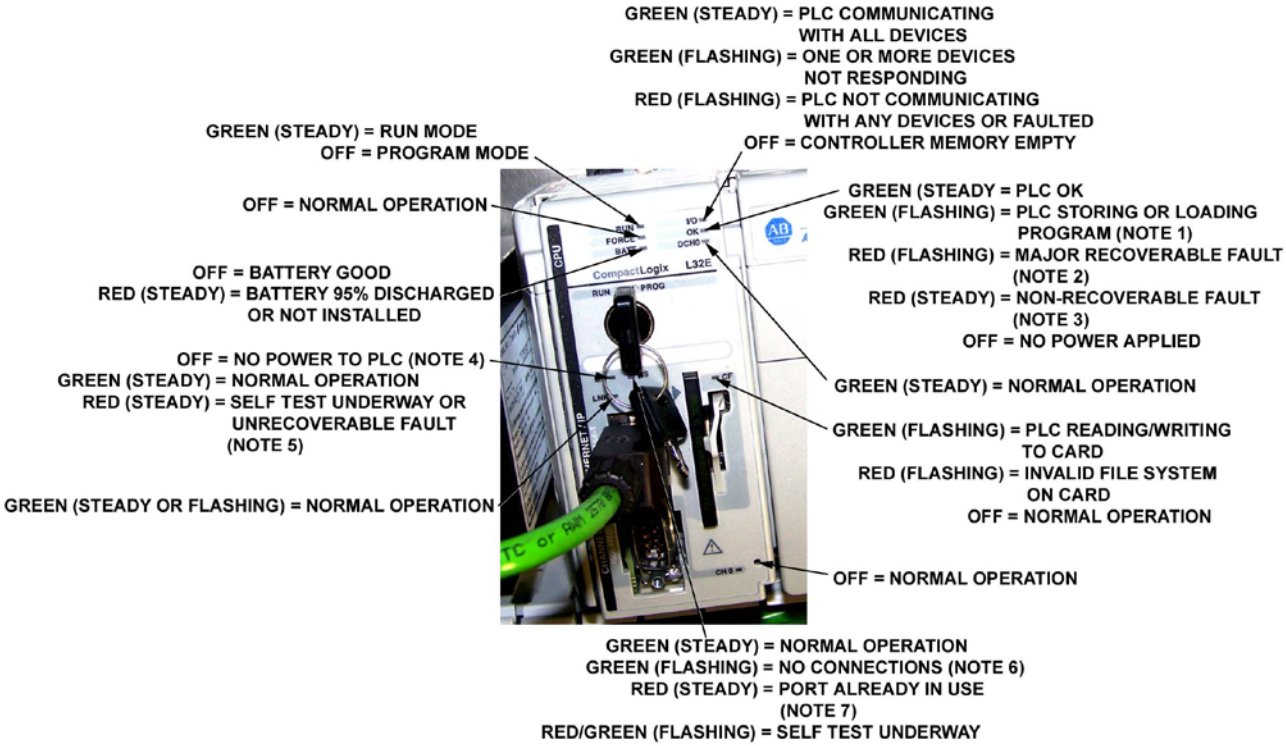

NOT ENABLED = BOWL OVERSPEED FAULT
E-STOP BUTTON PUSHED
VIBRATION SWITCH TRIPPED
RUNNING = NORMAL RUNNING CONDITION
STOP ASSERTED = NORMAL OPERATION
BUT CENTRIFUGE STOPPED
GREEN = DRIVE ON
OFF = DRIVE OFF
GREEN (STEADY) = DRIVE RUNNING
GREEN (FLASHING) = DRIVE READY BUT NOT RUNNING;
NO FAULTS PRESENT
YELLOW (FLASHING OR STEADY) = ALARM PRESENT OR
DRIVE NOT ENABLED
RED (FLASHING OR STEADY) = FAULT
RED = FAULT PRESENT
GREEN (STEADY) = DRIVE FUNCTIONAL
GREEN (FLASHING) = DRIVE FUNCTIONAL

Figure 5-18. VFD Indicators


GREEN (STEADY) = PLC COMMUNICATING WITH ALL DEVICES
GREEN (FLASHING) = ONE OR MORE DEVICES NOT RESPONDING
RED (FLASHING) = PLC NOT COMMUNICATING WITH ANY DEVICES OR FAULTED
OFF = CONTROLLER MEMORY EMPTY
GREEN (STEADY) = RUN MODE
OFF = PROGRAM MODE
OFF = NORMAL OPERATION
OFF = BATTERY GOOD
RED (STEADY) = BATTERY 95% DISCHARGED OR NOT INSTALLED
OFF = NO POWER TO PLC (NOTE 4)
GREEN (STEADY) = NORMAL OPERATION
RED (STEADY) = SELF TEST UNDERWAY OR UNRECOVERABLE FAULT (NOTE 5)
GREEN (STEADY OR FLASHING) = NORMAL OPERATION
GREEN (STEADY = PLC OK
GREEN (FLASHING) = PLC STORING OR LOADING PROGRAM (NOTE 1)
RED (FLASHING) = MAJOR RECOVERABLE FAULT (NOTE 2)
RED (STEADY) = NON-RECOVERABLE FAULT (NOTE 3)
OFF = NO POWER APPLIED
GREEN (STEADY) = NORMAL OPERATION
GREEN (FLASHING) = PLC READING/WRITING TO CARD
RED (FLASHING) = INVALID FILE SYSTEM ON CARD
OFF = NORMAL OPERATION
OFF = NORMAL OPERATION
GREEN (STEADY) = NORMAL OPERATION
GREEN (FLASHING) = NO CONNECTIONS (NOTE 6)
RED (STEADY) = PORT ALREADY IN USE (NOTE 7)
RED/GREEN (FLASHING) = SELF TEST UNDERWAY

NOTES:
1. WAIT FOR MEMORY LOAD TO COMPLETE.
2. TURN PLC KEY SWITCH FROM "PROG" TO "RUN" AND THEN BACK TO "REM"; THEN CYCLE POWER OFF AND ON.
3. CYCLE POWER OFF AND ON.
4. CHECK PLC POWER SUPPLY.
5. CYCLE POWER OFF AND ON. IF PROBLEM FAILS TO CLEAR, REPLACE PLC.
6. CHECK DRIVE CONNECTIONS AND DRIVES.
7. TWO CENTRIFUGES CONNECTED TOGETHER (NETWORKED). MACHINES MUST BE SEPARATE.

Figure 5-19. PLC Indicators

CONTROL COMPONENT INDICATORS (CONT'D)

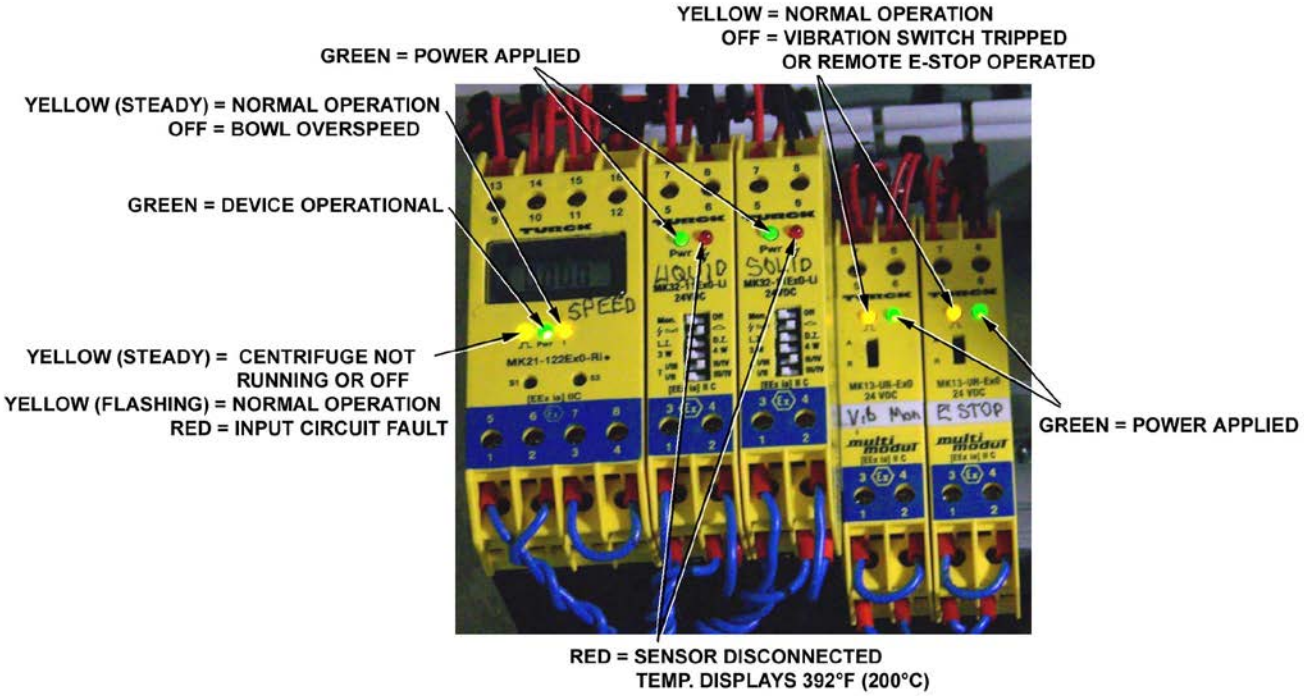

YELLOW = NORMAL OPERATION
OFF = VIBRATION SWITCH TRIPPED
OR REMOTE E-STOP OPERATED
GREEN = POWER APPLIED
YELLOW (STEADY) = NORMAL OPERATION
OFF = BOWL OVERSPEED
GREEN = DEVICE OPERATIONAL
YELLOW (STEADY) = CENTRIFUGE NOT
RUNNING OR OFF
YELLOW (FLASHING) = NORMAL OPERATION
RED = INPUT CIRCUIT FAULT
GREEN = POWER APPLIED
RED = SENSOR DISCONNECTED
TEMP. DISPLAYS 392°F (200°C)

Figure 5-20. Transmitter/Intrinsic Barrier Indicators

Figure 5-21. Power Supply Indicators

SECTION 8 - REFERENCE DRAWINGS

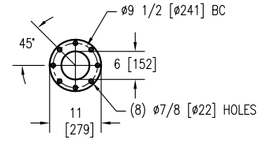
This section contains Derrick engineering drawings for your equipment. These drawings are included to provide assistance in troubleshooting, repair, and parts ordering.

Number	Title
14738-00-008 -	General Arrangement, DE-1000LP VFD Centrifuge
14394-00-023 -	Electrical Wiring Schematic, DE-1000LP 460/480V 60 Hz XP Centrifuge
9587-00-007 -	Rotating Assembly, DE-1000 Centrifuge (Radial Flow)
11372-01 -	Gear Unit - DE-1000 Centrifuge, 52:1
10647-00-010 -	Lubrication & Maintenance Schedule, DE-1000LP Centrifuge
14894-00 -	Rotating Assembly, Hardware Parts List
16615-00 -	Parts list, DE-1000 Base Sensor System
16622-00-005 -	XP Electrical Control Panel, DE-1000 VFD
16545-00-006 -	DE-1000-LP Control Enclosure Assembly, XP

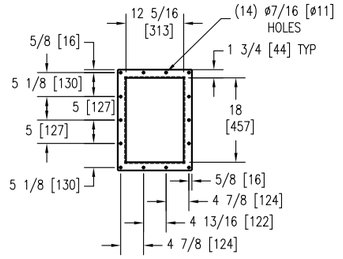
QTY.	No.	PART NAME	DESCRIPTION
4	EE	HINGE PLATE	13490-01-003
2	DD	BASE GAS SPRING MOUNT 2	18056-03
2	CC	BASE GAS SPRING MOUNT 1	18056-02
2	BB	GAS SPRING	G0012457
1	AA	COVER SAFETY PIN ASSEMBLY	18059-02
1	Z	COVER HANDLE	18061-01
2	Y	COVER HINGE 2	13490-02-006
2	X	COVER HINGE 1	13490-01-006
2	W	ENCLOSURE ISOLATOR MOUNT (REAR)	G0012076
1	V	VERTICAL MOTOR MOUNT	15968-01-002
1	U	TOOL KIT	12016-00-001
1	T	BUSHING - 2.125 BORE	G0003563
1	S	HUB SHEAVE - 8.0"	G0003562
1	R	DRIVE BELT	G0009762
6	Q	ISOLATOR MOUNTS	CA1595X1/2-6
1	P	ELECTRICAL ENCLOSURE ASSEMBLY	16622-01-006
2	O	ENCLOSURE ISOLATOR MOUNT (FRONT)	G0012075
1	N	GEAR UNIT 52:1	13223-22
1	M	CONTROL ENCLOSURE ASSEMBLY	16545-01-006
1	L	MOTOR-20HP	G0008902 *SEE NOTE 5*
1	K	MOTOR-50HP	G0008901 *SEE NOTE 5*
1	J	BELT GUARD	13985-01-004
1	H	FEED TUBE SUPPORT	9539-01
1	G	GEAR UNIT GUARD	9856-01-008
1	F	20 HP MOTOR MOUNT	14554-01-003
1	E	CASE COVER	9591-02-002
1	D	LOWER CASE	9590-01-003
1	C	SKID	13100-01-008
1	B	BASE	9589-01-002
1	A	ROTATING ASSEMBLY W/TILES	9587-01-007 *SEE MANUFACTURING SHEET*
01		RADIAL CENTRIFUGE ASSEMBLY (460/60HZ)	

NOTES:

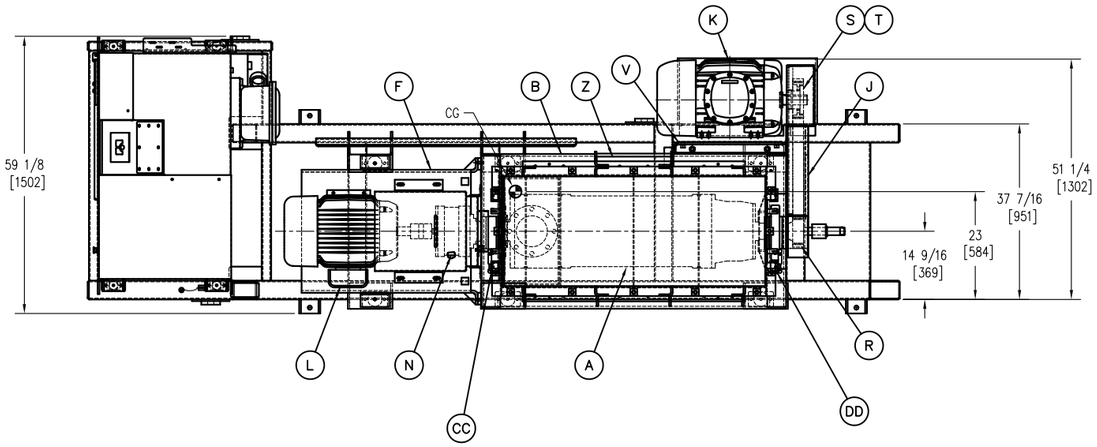
1) ONE (1) UNIT COMPLETE
2) COATING TYPE: PSX 700
3) LUBRICATION: SEE MANUFACTURING SHEET IN MANUAL
   A) MAIN BEARINGS - PER APPLICATION
   B) CONVEYOR BEARINGS - PER APPLICATION
   C) GEAR BOX - PER APPLICATION
4) OPERATING SPEED(S) - SEE MANUFACTURING SHEET IN MANUAL
5) MOTORS ARE EXPLOSION PROOF

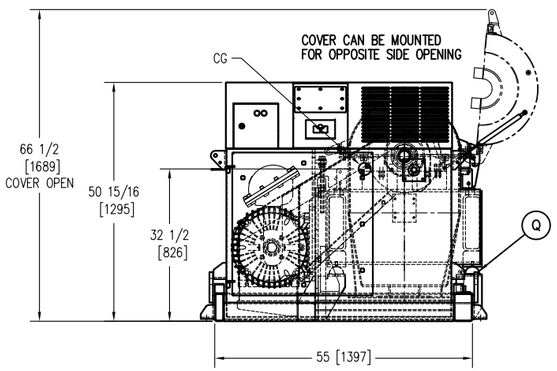


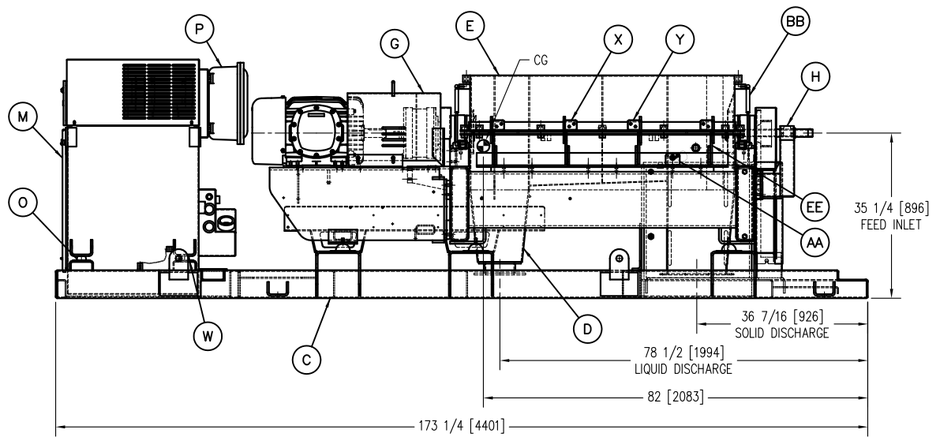
LIQUID DISCHARGE DETAIL



SOLID DISCHARGE DETAIL







REFERENCE DRAWINGS	
ELECTRICAL COMPONENTS PARTS LIST	16615-00
ELECTRICAL WIRING SCHEMATIC	14394-00-023
LUBRICATION & MAINTENANCE	10647-00-010

⚠ STATIC LOAD- 7420 LBS [3366 KG]
MAX TRANS DYNAMIC LOAD-135 LBS [62 KG]

APPROX WGT: 7420 LBS [3366 KG]

REV	CHANGE	CKD	DATE
7	ADDED STATIC AND MAX TRANS DYNAMIC LOADS	EJR	8/13/12
6	ADDED ITEM EE, UPDATED VIEWS.	CCS	7/30/12
5	ADDED ITEMS BB THRU DD	WDS	6/25/12
4	ADDED ITEMS X THRU AA.	CCS	5/24/12
3	ITEM O WAS G0008128 AND QTY WAS 4, ADDED ITEM W, PER DRR# 2560	EJR	5/25/11
2	ITEM A WAS 9587-00-005.	CCS	2/22/11
1	ADDED ITEM V	EJR	2/16/11

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TITLE: GENERAL ARRANGEMENT FOR DE-1000LP VFD CENTRIFUGE (460/60/3)

DWN NVB | CKD | DATE 9/26/00 | SCALE 1:20 | REV 7

SHEET SIZE C | F C | DWN CCS 11/10/10 | CKD

DRAWING NO. 14738-00-008

DERRICK® CORPORATION 590 DUKE ROAD BUFFALO, NY 14225 U.S.A.

LO, WE, CENT, MAN

XP CABLE ASSY W/CABLE GLAND (6C-#16AWG) (G0009767)
ELBOW 3/4" (CRH-EL29)
NIPPLE 3/4" (NPLE-75-COND)

CONDENSOR FAN MOTOR 0.5HP-1.1A 460 VAC 60 Hz 3 PH

0.5HP MOTOR (G0007588)

3/4" NPT CORD FITTING (TBS-2535)

PURGE SYSTEM (G0007865)
I.S. SWITCH
+ BLU
2 CLR

(G0003533) 1/2" NPT CORD FITTING-90
(G0013391) 1/2" LOCKNUT
(G0009340) 1/2" GASKET
(PP1290) 1/2" BUSHING

TUBE (G0009864)
ELBOW (G0009863)
RELIEF VALVE (G0008006)

FEED PUMP INPUT FUSES
FUSE HOLDER (G0003486)(3)
FUSES-40 AMP (G0003484)(3)

CENTRIFUGE BOWL INPUT FUSES
FUSE HOLDER (G0007585)(3)
FUSES-100 AMP (G0007583)(3)

FUSE HOLDER (G0007214)
FUSES-15 AMP (G0003493)(3)

FUSE HOLDER (G0007214)
FUSES-10 AMP (G0008792)(3)

AIR CONDITIONER (G0009813)

THERMOSTAT INPUT CONTROL 24VDC X3

TEMP RTD SENSOR 4-20MA OUTPUT

(G0009974 SENSOR) (G0009972 CABLE)

CONVEYOR CONTROLLER 20HP (G0007241)

FEED PUMP CONTROLLER 15HP (G0008380)

BOWL CONTROLLER 50HP (G0008359)

24VDC

120VAC BLK WHT THHN-14 AWG

PLC (G0007228) BATTERY RJ45 (G0008349) ETHERNET MEMORY CARD COMPACTFLASH (G0007995)

POWER SUPPLY 120 V 2 A (G0007229)

END BARRIER (G0007230)

ETHERNET RJ45 HMI (G0007976)

USB/PS2 ASSY (17006-02)

MOUSE/POINTER ASSY (17006-01)

+24VDC POWER SUPPLY 24 VDC, 5 AMPS (G0003552)

TERMINAL BLOCKS TB3
(G0008562)X(5) GREY 4 PT
(G0009324)GREEN 4 PT
(G0008563)ORANGE 4 PT
(G0008507)X(2) END

RED 18 AWG

EMERGENCY STOP PUSHBUTTON (G0006325)
EMER STOP CIRCULAR LEGEND (G0007244)

ETHERNET CABLE (G0009873)

ETHERNET CABLE (G0007951)

CONNECT SHIELD GROUNDED END OF ETHERNET CABLE AT SWITCH (MARKED W/GREEN TAPE)

ETHERNET SWITCH (G0007231)

ETHERNET CABLE (G0009871)

ETHERNET CABLE (G0009872)

ETHERNET CABLE (G0009873)

THHN-18 AWG

18 AWG SHIELDED

32 RED

31 BLK

30 RED

25 BLK

AN13A BLK AN9A RED

AN13A BLK AN4A RED

AN13B BLK AN4B RED

INTRINSIC BARRIER (G0009286)

INTRINSIC BARRIER (17244-01)

INTRINSIC BARRIER (17325-01)

VIBRATION MONITOR

SPEED SENSOR

LIQUID END

SOLID END

BLUE INTRINSIC WIRING 18AWG

INTRINSIC TERMINAL BLOCKS TB1
(G0008571)X2)GREEN 2 PT
(G0008544)ORANGE 2 PT
(G0004286)X2) END

NON-INTRINSIC TERMINAL BLOCKS
TB2
(G0009324)X3)GREEN 4 PT
(G0008562)X10 GREY 4 PT
(G0008563)X1)ORANGE 4 PT
(G0009839)X2) JUMPER 2 PT
(G0004286)X2) END

GROUND SHIELDS AT THIS END ONLY

GROUND SHIELDS THIS END ONLY

EQUIPMENT GROUND

THERMOSTAT SET TO CLOSE @ 40F (G0012049)

1200 W SPACE HEATER W/THERMOSTAT 120V (G0012047)

2000 VA TRANSFORMER (G0012013)

TERMINAL COVERS (G0002873)

POWER DISTRIBUTION BLOCK (G0008889)
POWER DISTRIBUTION BLOCK COVER (G0008890)(3)

GROUND BUS BAR (G0005309)

INCOMING GROUND LUG (G0007213)

TERMINAL BLOCK (G0008891) (G0008892) (G0008893)(4)

TERMINAL BLOCK (G0008891) (G0008892) (G0008893)(4)

TERMINAL BLOCK (G0008891) (G0008892) (G0008893)(4)

1" NPT
1" NPT PLUG (SHPP-100)
CORD FITTING BY OTHERS
POWER CABLE XP SIZED FOR 27A MAX-PROVIDED BY OTHERS
PUMP SIZED FOR MAXIMUM 15HP/27FLA

PUMP MOTOR 15HP-21A 460 VAC 60 Hz 3 PH

PUMP AND MOTOR PROVIDED BY OTHERS

1 1/2" NPT CORD FITTING (G0008809)
XP CABLE ASSY W/CABLE GLAND (4C-#8AWG) (G0009698)

CONVEYOR MOTOR 20HP-27A 460 VAC 60 Hz 3 PH

CONVEYOR MOTOR (G0009597)

1 1/2" NPT CORD FITTING (G0001686)
XP CABLE ASSY W/CABLE GLAND (4C-#4AWG) (G0009899)
XP REDUCER 2"NPT-1 1/2"NPT (G0012559)

BOWL MOTOR 50HP-65A 460 VAC 60 Hz 3 PH

BOWL MOTOR (G0009596)

1" NPT PLUG (SHPP-100)

FLOW METER INTERFACE

1" NPT PLUG (SHPP-100)

SPARE

1" NPT PLUG (SHPP-100)

INTRINSICALLY RATED SHIELDED CABLE 18AWG-18CU (G0008403)(85')

1/2" NPT CORD FITTING (G0001687)

CONTROL CIRCUIT JUNCTION BOX (16584-01-004)

VIBRATION SWITCH (G0003015 SWITCH) (G0007163 CABLE)

TEMPERATURE SENSOR SOLID END (G0008089)

TEMPERATURE SENSOR LIQUID END (G0008090)

SPEED SENSOR (G0007861 SENSOR) (G0007862 CABLE)

3/4" NPT CORD FITTING (TBS-2535)

1/0-4/C XP CABLE ASSY W/CABLE GLAND (G0009788)

XP ENCLOSURE ASSY (16622-01-006)

2-1/2" NPT CORD FITTING (G0009811)

CENTRIFUGE POWER JUNCTION BOX

10 AMP RELAY (G0009963)

INTRINSIC BARRIER (G0009286) SET TO NO, WB-OFF, SC-OFF

XP CABLE ASSY W/CABLE GLAND (17382-01)

ELBOW M-F 3/4" (G0008214)

100 AMP CONTACTOR (G0008660)

FUSE HOLDER (G0009182)(1)
FUSE 5 AMP (G0009451)(2)

FUSE 0.3 A (G0004195) 460VAC

FUSE 1.25 A (G0009298)

FUSE 10 A (G0004195)

100 VA TRANSFORMER (G0002481)

THHN/THWN -14 AWG GROUND LUG (G0008896)

3/4" NPT ELBOW (CRH-EL296)

XP CABLE ASSY W/CABLE GLAND (6C-#16AWG) (G0012062)

2" NPT PLUG (SHPP-200)

SURGE PROTECTOR (G0002564)

FUSE HOLDER (G0012010)(2)
FUSE 15 A (G0012008)
FUSE 5 A (G0012009)

THHN-14-STR-BLK
THHN-14-STR-WHT

SUPPLY 480 VOLTS 3 PH 60 HZ
RECOMMEND 125 AMP SERVICE
BASED ON CONNECTED LOAD OF 100 AMP
MAIN POWER DISCONNECT
SUPPLIED BY CUSTOMER

RECOMMENDED CABLE HOOK-UP
QTY (1) COPPER COND PER PHASE SIZED FOR 125 AMP AT 75C TEMP RISE AND 40C AMBIENT
USE XP SEALING GLAND FOR A 2" NPT

PUMP RESTART
REMOTE N.O. CONTACT
(BY OTHERS)
WHEN CLOSED AND
PROGRAMMED
PUMP WILL RESTART
(IF PUMP WAS RUNNING)

PUMP ENABLE
REMOTE N.O. CONTACT
(BY OTHERS)
WHEN CLOSED AND
PROGRAMMED
PUMP IS ENABLED
TO RUN

NOTE:
CABINET IS SHIPPED WITH TERMINALS 3 AND 4 JUMPERED TO BE REMOVED BY CUSTOMER IF REMOTE PUMP ENABLE IS USED

DO NOT PLACE JUMPER BETWEEN TERMINALS 1 AND 2 AS PUMP MAY START UNINTENTIONALLY

THESE TERMINALS ARE NOT INTENDED FOR INTRINSICALLY SAFE CIRCUITS
CONTACT DERRICK CORPORATION IF REMOTE PUMP START/STOP CONTACTS ARE TO BE LOCATED IN A HAZARDOUS AREA

REV 2 USED FIRST ON CENTRIFUGE #CF1415 AND CONTROL PANEL CF6031

REV 4 USED FIRST ON CENTRIFUGE #CF1445 AND CONTROL PANEL CF6043

REV 9 USED FIRST ON CENTRIFUGE #CF1699 AND CONTROL PANEL CF6197

REF. G.A. # 14738-00-008
REF. P.L. 16545-00-006
REF. ELP # 16615-00-002

REV	CHANGE	CKD	DATE
12	CHANGE INTRINSIC BARRIER TO 17325-01(WAS G0007918),	BJS	07/08/13
	REVISE G0004288(WAS G0005288), ADD XP REDUCER TO BOWL MOTOR, ADD G0013391, G0009340, PP1290	JBC	
11	REVISE QTY OF NON-INTRINSIC TERMINALS, REVISE END STOPS	BJS	05/22/13
	ADD FLOW METER INTERFACE TERMINALS 41-42, ADD 1"NPT CONDUIT HOLE	JBC	
10	REVISE BOWL & CONV CABLE ASSY (WAS 17378-01 & 17279-01), REVISE INCOMING CABLE ASSY (WAS 17377-01), ADD RELIEF VALVE	BJS	06/08/12
		JBC	
9	OMIT REDUCER AT BOWL MOTOR(CHANGED GLAND TO 1.50 ENTRY) ADD WIRE NUMBERS 2-8, 10,12-14,22, ADD WIRE LABELS AT 16584-01-004	BJS	02/06/12
	REVISE CIRCUIT FEEDING AIR CONDITIONER NOW USES 24VDC (WAS 230VAC) & REVISE COLOR REVISE GROUND BAR (WAS G0007810), REVISE EPL REFERENCE DRAWING (WAS 16615-00)	JBC	
8	REVISE HAR TO PROGRAMMED PART (WAS G0008825)	BJS	05/22/13
	REVISE ETHERNET CABLES (WERE G0009968, -9967, -9968, -9969)	JBC	
7	REV DC BUS FUSE/HOLDER (WAS G0007862(2) AND G0007863(2)), REV DC- WIRE TO WHITE	BJS	10/11/11
	REVISE WIRING TO TEMPERATURE SENSOR, REVISE TEMPERATURE SENSOR (WAS G0009973)	JFS	
6	ADD FITTINGS AT CONDENSOR MOTOR AND XP ENCLOSURE INTRINSIC WIRE	JBC	09/28/11
		JFS	
5	MINOR WIRING REVISIONS TO REFLECT ACTUAL WIRING	JBC	07/05/11
		MC	
4	REVISE CORD FITTING AT PURGE UNIT (WAS G0004418), REVISE CABLE ASSEMBLY NUMBERS (G0009767 WAS 11881-01-025, G0012062 WAS 11881-01-026)	JBC	05/24/11
	ADD ENCLOSURE HEATER AND 2000 VA CPT, OMIT 500VA CPT, ADD THERMOSTAT, RELAYS, FUSES AND RELATED WIRING, CHANGE XP ENCLOSURE (WAS 16622-00-005)	DSD	
3	REVISE WIRE SIZES FOR BOWL AND CONVEYOR (WAS 8AWG-BOWL AND 10AWG-CONVEYOR)	JBC	04/12/11
		DSD	
2	INTERCHANGED POSITIONS OF SPEED SENSOR AND TEMP. SENSOR SOLID END, REORDERED TERMINAL BLOCK LABELING TO MATCH JUNCTION BOX ASSEMBLY.	JBC	03/18/11
	ADD RTD SENSOR FOR THERMOSTAT AND WIRING TO AC UNIT AND CONVEYOR CONTROLLER REVISE DC BUS WIRE (WAS 10GA)	DSD	04/05/11
1	REVISE RECOMMENDED SERVICE SIZE (WAS 150A BASED ON 110A CONNECTED LOAD)	JBC	03/18/11
	CHANGED ORDER OF TERMINAL BLOCK WIRING IN 16584-01-004 JUNCTION BOX SPARE CONNECTIONS WERE TERMINALS 1 & 2, V1 - SE2 WERE TERMINALS 3 THROUGH 12.	DSD	
REV	CHANGE	CKD	DATE

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VFD XP DE-1000-LP CENTRIFUGE LOW PROFILE
ELECTRICAL WIRING SCHEMATIC 460/480V 60 HZ

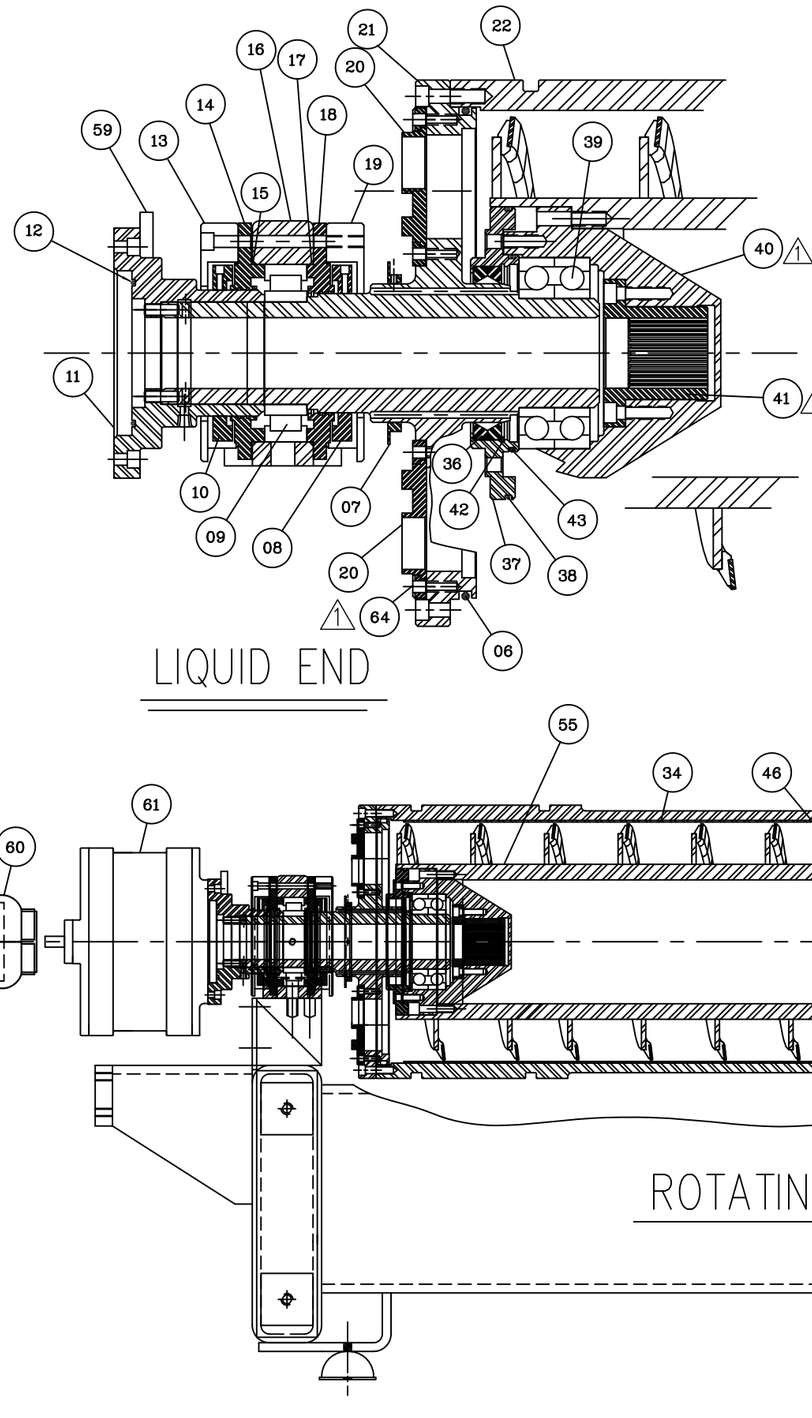
DWN BWE CKD JFS DATE 02/07/03 SCALE NONE WT 12

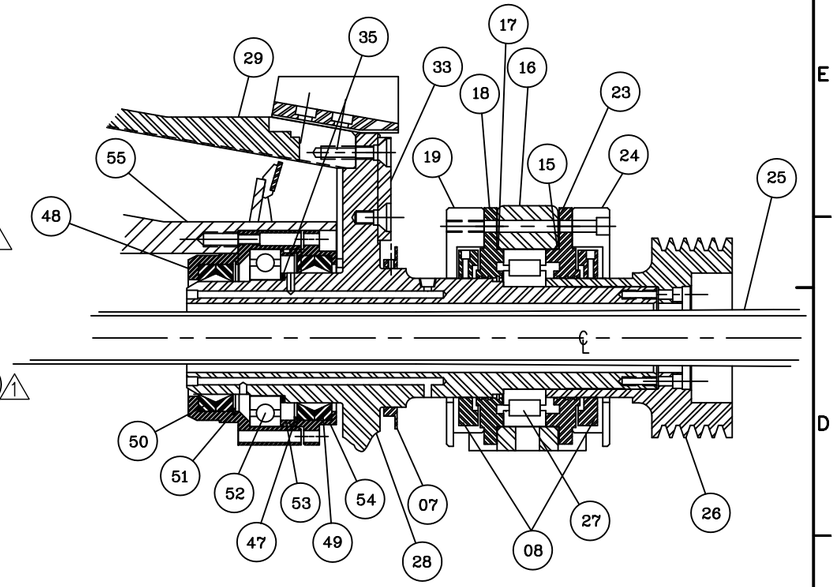
DRAWING NO. 14394-00-023 SHEET SIZE D FSCM 12 DWN JWC 12/07/10 CKD JFS 12/15/10

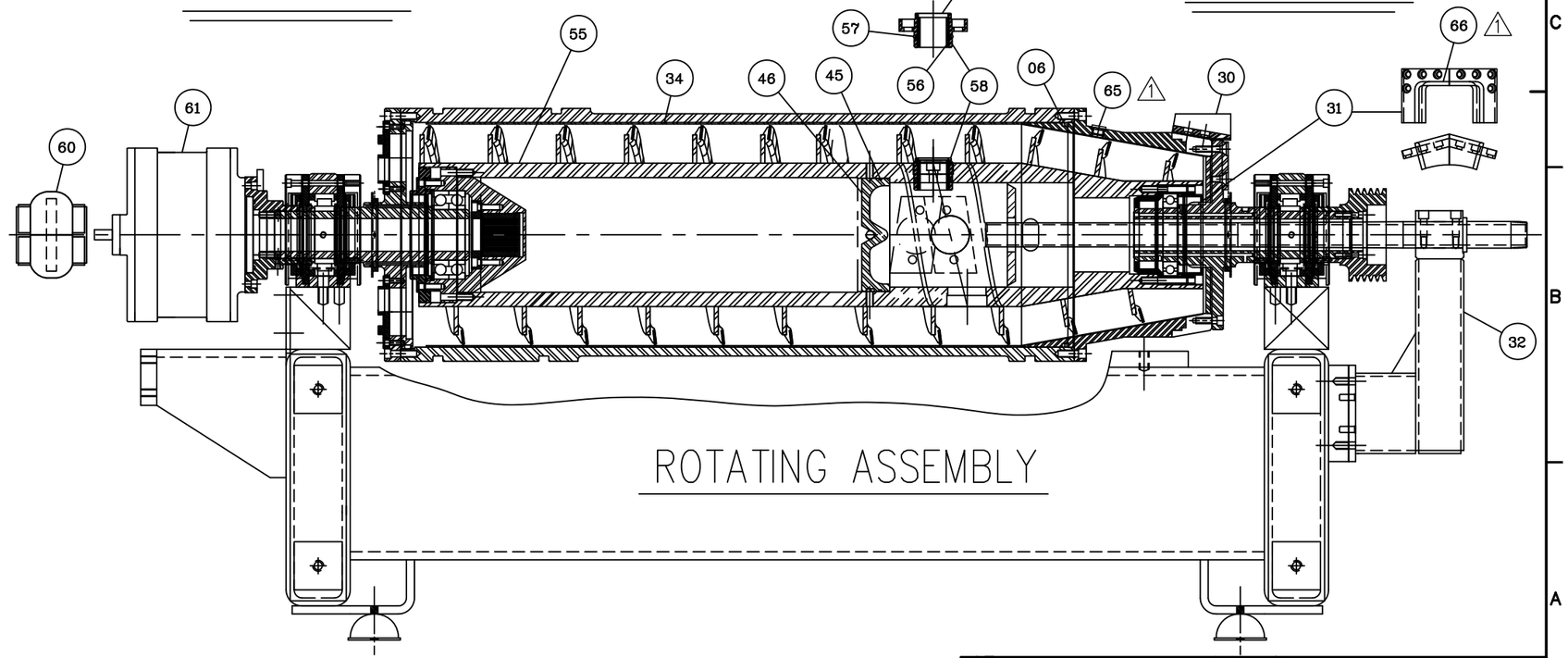
DERRICK® CORPORATION
590 DUKE ROAD BUFFALO, NY 14225 U.S.A.

					1	1	66	O-RING STOCK	70D-NIT-CORD-21	⚠1
					1	1	65	HEX PLUG	PKR-8-HP5ON-SS	⚠1
W	C				4	4	64	MOUNTING RING	10668-02	⚠1
							63			⚠3
							62			⚠3
					1	1	61	GEARBOX	13223-22	
					1	1	60	COUPLING	G0008125	
					2	2	59	SPEED SENSOR TAB	16669-01	
	B	1					58	FEED NOZZLE - CASTING	9524-03	
	B	1					57	O-RING 227 (9524-02)	CS10-RA-324-00	
W	B	1					56	CARBIDE INSERT (9524-01)	CS10-RA-629-TC	
	B		1				55	4 1/4" SINGLE LEAD CONVEYOR	9562-01-007	
	B		1	1			54	SEAL HOUSING S/E	9533-00	
	B		1	1			53	O-RING 249	CS10-RA-325-00	
	B		1	1			52	BALL BEARING 6017	CS10-RA-511-00	
	B		1	1			51	RETAINER RING RR425	CS10-RA-327-00	
	B		2	2			50	SEAL (GARLOCK 24600-7374)	CS10-RA-310-00	
	B		2	2			49	SEAL (GARLOCK 24600-2462)	CS10-RA-311-00	
	B		1	1			48	BEARING HOUSING S/E	9553-00-001	⚠2
	B		1	1			47	RETAINER RING RR475	CS10-RA-328-00	
W	B		1	1			46	FEED ACCELERATOR BUMP	9537-00	
	B		1	1			45	O-RING 261	CS10-RA-323-00	
	B			1			44	4 1/4" SINGLE LEAD CONVEYOR	9562-01-005	
	B		1	1			43	O-RING 252	CS10-RA-322-00	
	B		1	1			42	RETAINING RING RR500	CS10-RA-326-00	
	B		1	1			41	SPLINE HUB	9519-00	
	B		1	1			40	BEARING HOUSING L/E	9521-00	
	B		2	2			39	THRUST BEARING 7216	CS10-RA-510-00	
	B		1	1			38	O-RING 266	CS10-RA-321-00	
	B		1	1			37	SEAL HOUSING L/E	9511-00	
	B		2	2			36	SEAL (GARLOCK 24600-0978)	CS10-RA-312-00	
					1	1	35	WAVE SPRING	G0004365	
W	A				1	1	34	BOWL LINER	9592-00	
W	D				1	1	33	BOWL HEAD PLOW (10579-00)	CS10-RA-650-IC	*
	E				1	1	32	FEED TUBE SUPPORT	9539-01	
W	A				1	1	31	SOLIDS DISCH. WEAR INSERTS (9547-00)	CS10-RA-630-IC	*
W	A				1	1	30	BOWL EXTENSION PLOW	9552-00	
	A				1	1	29	BOWL EXTENSION	9462-00	
	D				1	1	28	SOLID BOWL HEAD	9463-00-001	⚠3
	D				1	1	27	BEARING NUP-2215	CS10-RA-512-00	
	D				1	1	26	PULLEY SHEAVE 5.75" PD	9546-00	
	E				1	1	25	FEED PIPE	9540-00	
	D,C				1	1	24	FLINGER COVER (OUTBOARD)	9670-00	
	D,C				1	1	23	PILLOW BLOCK COVER (OUTBOARD)	9588-00	
	A				1	1	22	BOWL	9523-00	
	C				1	1	21	LIQUID BOWL HEAD	9505-00-001	
W	C				4	4	20	EFFLUENT PORTS	10668-01	⚠1
	D,C				2	2	19	FLINGER COVER (INBOARD)	9817-00	
	D,C				2	2	18	PILLOW BLOCK COVER (INBOARD)	9512-00	
	D,C				2	2	17	O-RING (4.989 ID X .070)	G0003212	
	D,C				2	2	16	PILLOW BLOCK	9545-00-002	
	D,C				2	2	15	O-RING (4.987 ID X .103)	G0003211	
	D,C				1	1	14	PILLOW BLOCK COVER (OUTBOARD FLANGE SIDE)	9588-00-002	
	D,C				1	1	13	FLINGER COVER (OUTBOARD FLANGE SIDE)	9670-00-001	
	C				1	1	12	O-RING (4.000 ID X .125)	ORVI-ARP-242	
	C				1	1	11	GEAR FLANGE	9522-00-001	
	D,C				1	1	10	PILLOW BLOCK FLINGER (OUTBOARD FLANGE SIDE)	9514-00-001	
	C				1	1	09	BEARING NU 2215	CS10-RA-513-00	
	D,C				3	3	08	PILLOW BLOCK FLINGER	9514-00	
	D,C				2	2	07	CASE FLINGER	9815-00	
	A				2	2	06	O-RING 456	CS10-RA-316-00	
W	B	X	4	4			05	FEED NOZZLE ASSY.	9524-00	
		X		1			04	CONVEYOR ASSY W/ HARD SURFACING		
		X				1	03	CONVEYOR ASSY W/ TILES		
		X					02	COMPLETE ROTATING ASSY W/ H.S.		
	B	X					01	COMPLETE ROTATING ASSY W/ TILES		
WEAR ITEMS	ASSY. REF.	QTY			ITEM#			DESCRIPTION	DWG. NO.	

⚠ * - COMPLETE SET







⚠2 GA REF 14738-00-008

REV	CHANGE	CHD	DATE
3	REMOVED ITEM 42 (SEAL HSG) EXTENDED 17281-01) & ITEM 43 BEARING HOUSING FLANGED 17283-01) ADD 20 THIS DWG-00, ADDED TEXT NOTE TO THE BLOCK, CHANGES PER ENGINEERING	KW	6/25/13
2	ITEM 48 WAS 9553-00, CORRECTED GA REF DWG #	KW	5/28/13
1	REVERSED ITEM 41 & 40 POINTING TO WRONG PARTS, ADDED ITEMS 64, 65 & 66, REVISED NEW TO ADD ITEM 65, CHANGES PER ERR 2680, ADDED NOTE, ITEM 20 WAS 10668-00	JAM	2/8/12

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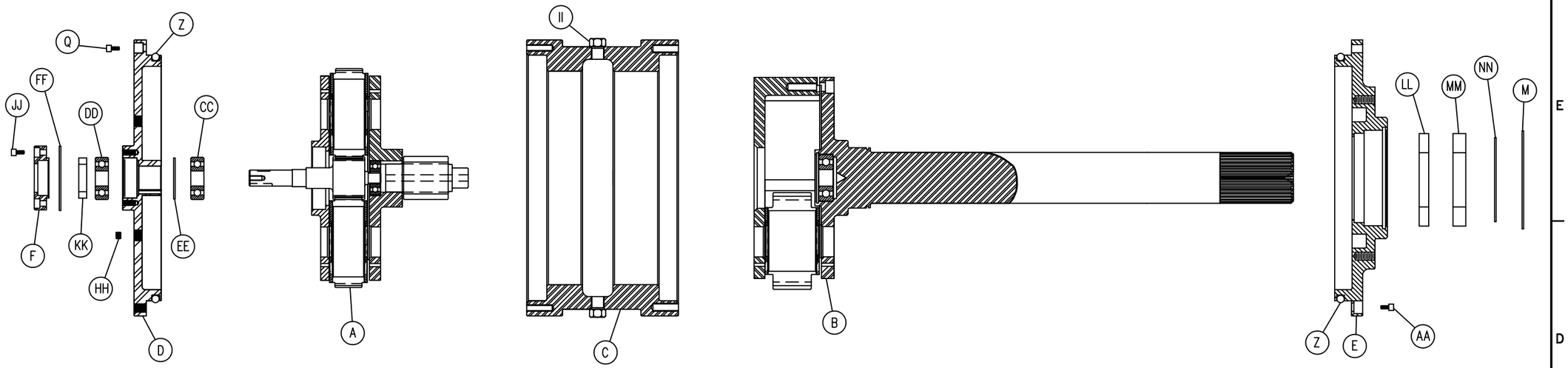
DRN	KW	CHD	TS
DATE	2/24/92	SCALE	1=4,1=2
REV	⚠3		
D	Y	DRN	CCS 2/22/11
SHEET SIZE	F C	CHD	

TITLE: CENTRIFUGE - ROTATING ASSEMBLY FOR DERRICK® DE-1000LP ("BOS" UNITS)

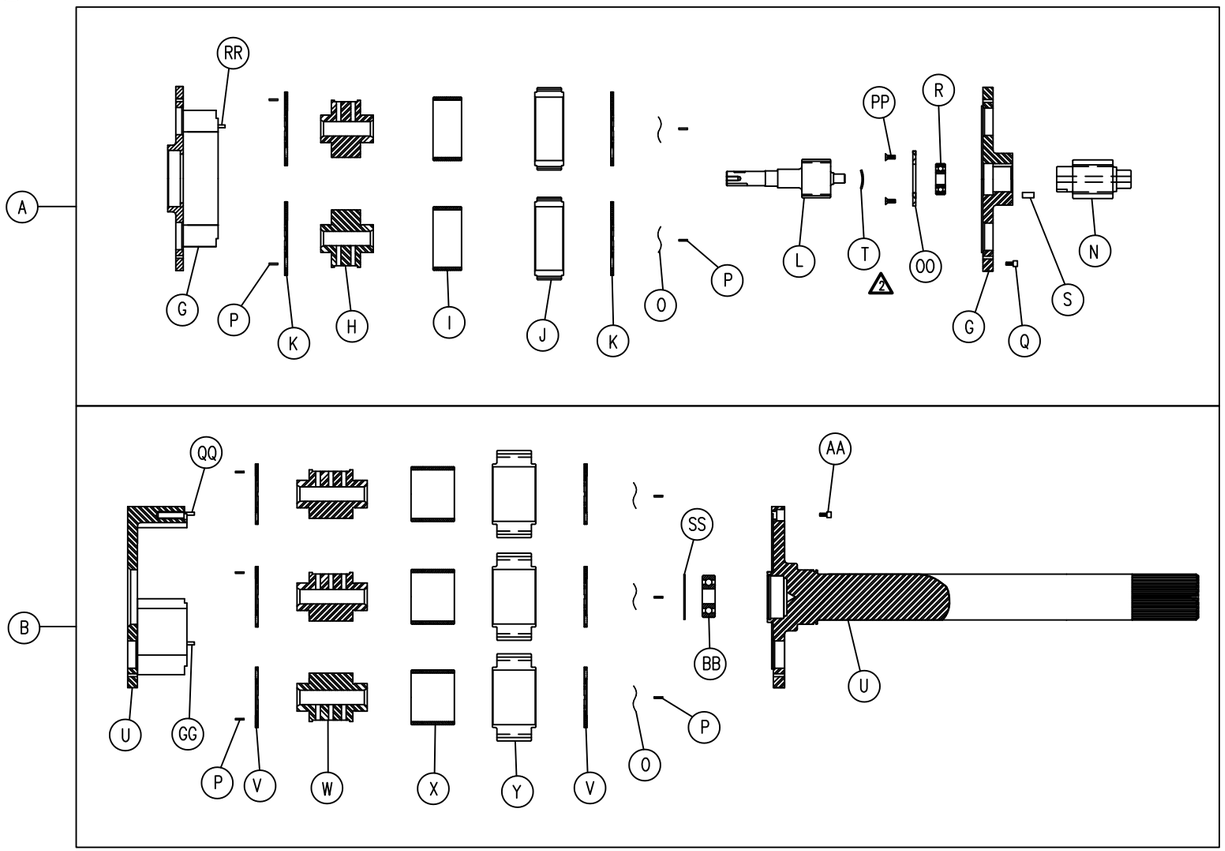
DRAWING NO. 9587-00-007

DERRICK® CORPORATION
280 DUKE ROAD BUFFALO, NY 14225 U.S.A.

CONT. C-RU



1	1			SS	RETAINING RING	CS10-GU-319-00
		2		RR	DOWEL PIN	PP1361
	2			QQ	DOWEL PIN	PP1362
		2		PP	MACHINE SCREW	G0003040
		1		OO	RETAINER PLATE	**11033-00**
			1	NN	RETAINING RING	CS10-GU-318-00
			1	MM	SHELL REAR COVER BEARING	CS10-GU-508-00
			1	LL	SHELL REAR COVER SEAL	SEAL-0287-03631
			1	KK	SHELL FRONT COVER SEAL	CS10-GU-308-00
			4	JJ	HEX HEAD CAP SCREW	HXCS-10-24X75-8
			2	II	PLUG w/O-RING	IMP-721FSO-5
			2	HH	PIPE PLUG	SHPP-13
1	1			GG	DOWEL PIN	PP1354
			1	FF	SEAL HOUSING GASKET	**11373-00**
			1	EE	BEARING SPACER RING	**11374-00**
			1	DD	FIRST STAGE SUN GEAR BEARING	CS10-GU-505-00
			1	CC	BEARING - FIRST STAGE	CS10-GU-507-00
	1			BB	BEARING - SECOND STAGE	CS10-GU-506-00
	9		8	AA	HEX HEAD CAP SCREW	HXCS-31-18X75-8
			2	Z	O-RING	CS10-GU-309-00
	3			Y	SECOND STAGE PLANET GEAR	**11099-00**
	3			X	SECOND STAGE JOURNAL BUSHING	**11353-02**
	3			W	SECOND STAGE JOURNAL	**10988-00**
	6			V	SECOND STAGE THRUST WASHER	**11028-00**
1	1			U	CAGE AND CARRIER - SECOND STAGE	**13297008**
2 1		1		T	BELVILLE WASHER	PP1364
		1		S	KEY - 1/4 X 1/2	**11375-00**
		1		R	FIRST STAGE INNER BEARING	CS10-GU-503-00
		8	8	Q	HEX HEAD CAP SCREW	HXCS-25-20X63-8
	6	4		P	DOWEL PIN	PP1365
	3	2		O	WAVEY SPRING WASHER	PP1363
		1		N	SECOND STAGE SUN GEAR	**11101-00**
			1	M	RETAINING RING	CS10-GU-317-00
		1		L	FIRST STAGE SUN GEAR	**11100-00**
		4		K	FIRST STAGE THRUST WASHER	**10996-00**
		2		J	FIRST STAGE PLANET GEAR	**11098-00**
		2		I	FIRST STAGE JOURNAL BUSHING	**11353-01**
		2		H	FIRST STAGE JOURNAL	**10987-00**
		1		G	CAGE AND CARRIER - FIRST STAGE	**13299008**
			1	F	SEAL HOUSING	**11029-00**
			1	E	SHELL REAR COVER	**10905-00**
			1	D	SHELL FRONT COVER	**10986-00**
			1	C	SHELL	**10995-00**
			1	B	COMPLETE STAGE TWO ASSY	
			1	A	COMPLETE STAGE ONE ASSY	
			01		COMPLETE GEAR UNIT	
QTY			ITEM		DESCRIPTION	PART NUMBER



REV	CHANGE	CKD	DATE
2	ITEM T QUANTITY WAS 2.	MCP SDB	1/30/07
1	UPDATED DRAWING NUMBERS.	NVB	4/3/01

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TITLE: PARTS LIST
DE-1000™ GEAR UNIT 52:1

DWN WS | CKD TS | DATE 11/12/93 | SCALE NTS | REV 2

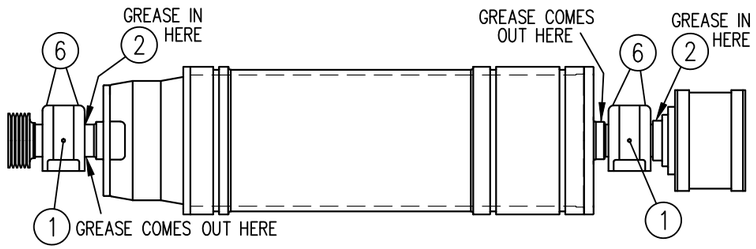
SIZE C | FSCM Y | DWN DJS 1/30/98 | CKD TOC 2/13/98

SHEET 1 OF 1

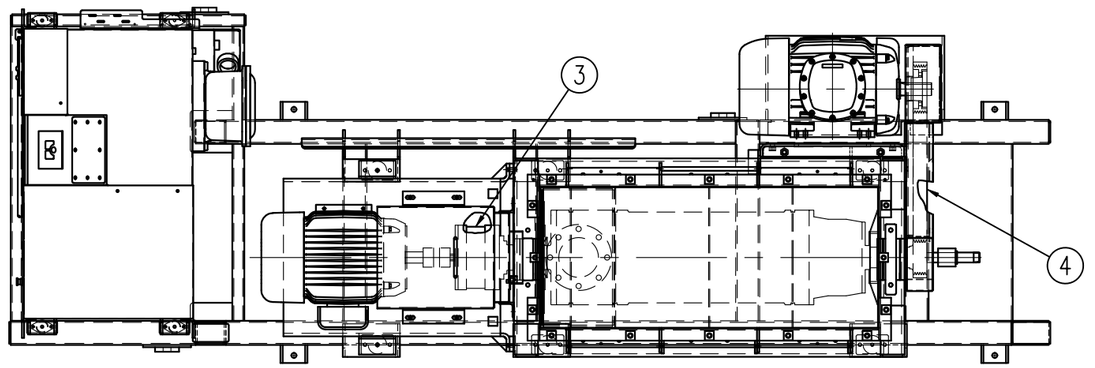
DRAWING NO. 11372-01

DERRICK® CORPORATION
590 DUKE ROAD BUFFALO, NY 14225 U.S.A.

CENT, MA, MAN

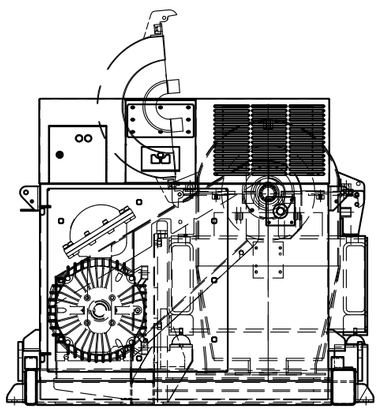


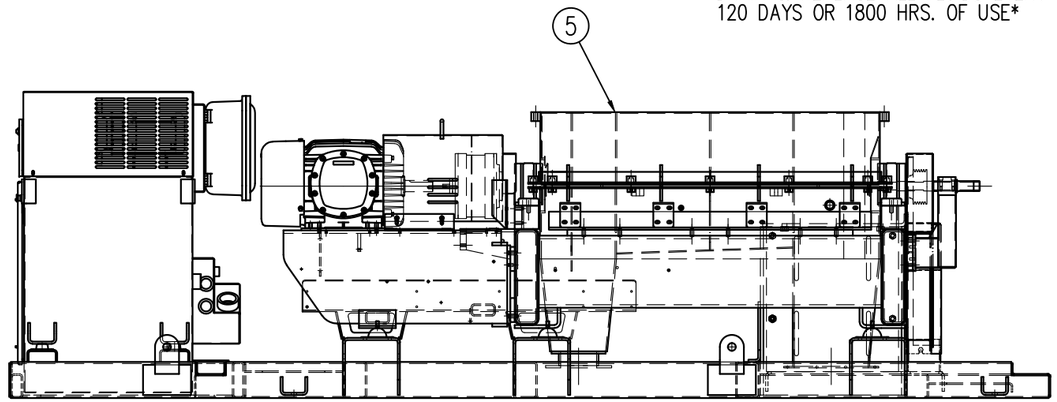
LUBRICATION & MAINTENANCE SCHEDULE		
MAINTENANCE OPERATIONS	SERVICE INTERVAL	LUB. TYPE (OTHER)
1) GREASE MAIN BEARINGS	1 SHOT DAILY	REFER TO B 1.1
2) PURGE CONVEYOR BEARINGS	BI-WEEKLY	REFER TO B 1.1
3) CHECK FLUID LEVEL: GEAR BOX HOLE @ 12:00	BI-WEEKLY	REFER TO B 1.1
4) CHECK BELT TENSION	BI-WEEKLY	20lbs.@ 1/2"
	INITIAL BREAK-IN	30lbs.@ 1/2"
5) CHECK CASE FOR SOLIDS	WEEKLY	VISUAL
6) CLEAN OUT UNDER FLINGER COVERS	MONTHLY	VISUAL



*MIXING LUBRICANTS MAY CAUSE CATASTROPHIC FAILURE

DRAIN & REPLACE ALL FLUIDS EVERY 120 DAYS OR 1800 HRS. OF USE





REV	CHANGE	CKD	DATE

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TITLE: LUBRICATION & MAINTENANCE SCHEDULE
DERRICK VFD CENTRIFUGE

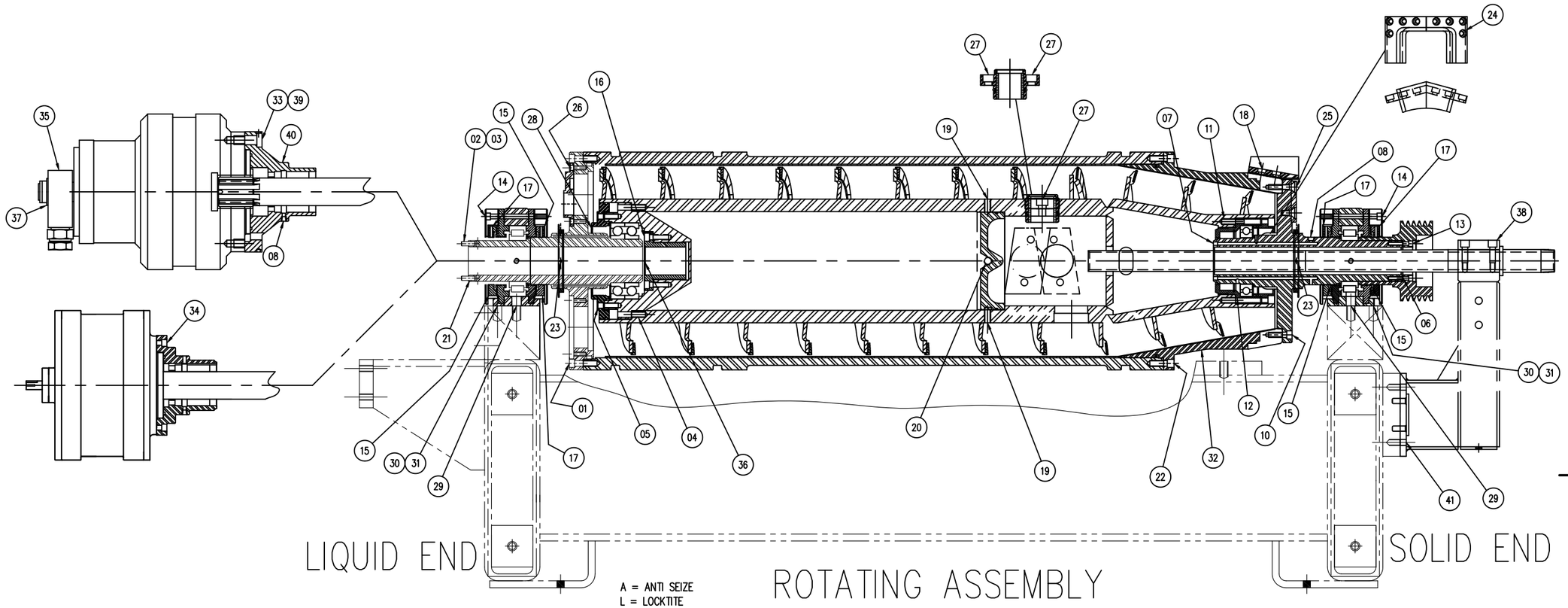
DWN	CKD	DATE	SCALE	REV
KW	TS	6/11/92	NTS	

SHEET SIZE		DWN	CKD
B	N	CCS 12/8/10	
	F C		

DRAWING NO. 10647-00-010

DERRICK® CORPORATION
590 DUKE ROAD BUFFALO, NY 14225 U.S.A.

MAN



ROTATING ASSEMBLY

A = ANTI SEIZE
L = LOCKTITE

△1	4	41	3/8-16 X 1 1/2 (HEX HEAD BOLT)	G0008180	N/A	A	FEED TUBE SUPPORT FLANGE
△5	1	40	5/16-18 X 1/2 ALY (SET SCREW CUP PT)	G0004184	N/A	A	FLANGE TO KEY
△6△3 ***	6	39	M16 X 40 (HEX SOCKET ALY)	13635-38	N/A	A	ROTODIFF TO ROTODIFF FLANGE
△7△1	4	38	3/8-16 X 2 1/2 (HEX HEAD BOLT)	G0008178	NO TORQUE	A	FEED TUBE MOUNTING BLOCK
**	1	37	30 x 1.5MM X 1.4W EXTERNAL SNAP RING	G0003966	N/A	N/A	ROTODIFF PORT BLOCK
	2	36	3/8 X 1 PIN (STEEL)	PP1354	N/A	680L	SPLINE HUB
**	1	35	3MM SET (SET SCREW)	PP1134-714	N/A	A	PORT BLOCK
	6	34	5/16-18 X 3/4 (HEX SOCKET)	SKCS-31-18X075	N/A	A	GEARBOX TO GEARBOX FLANGE
△3△2 ***	6	33	M16 X 35 (HEX SOCKET ALY/PLD)	13635-37	N/A	A	ROTODIFF TO ROTODIFF FLANGE
	1	32	#8 PLUG SS	PKR-8-HP50N-SS	35 FT-LBS	A	BOWL EXTENSION
△6△4	4	31	#7 PIN (3/8-24 X 2 1/2 STEEL)	13775-00	N/A	A	PILLOW BLOCK
	4	30	#8 PIN (7/16-20 X 2 1/2 STEEL)	G0003955	N/A	A	PILLOW BLOCK
△7△6△4	4	29	5/8-11 X 2 1/4 (HEX HEAD BOLT)	G0008202	197 FT-LBS	A	PILLOW BLOCK
	2	28	3/8-16 X 1/2 SS (SET SCREW CUP POINT)	G0003950	N/A	A	SEAL HOUSING
	8	27	1/2-13 X 1 SS (HEX SOCKET)	G0002156	53 FT-LBS	A	FEED NOZZLE
	12	26	5/16-18 X 7/8 SS (HEX SOCKET)	G0001578	144 IN-LBS	A	EFFLUENT PORT
	4	25	3/8-16 X 3/4 SS (FLAT HEAD HEX SOCKET)	FHSK-38-16X75-S	183 IN-LBS	A	SOLID HEAD PLOWS
	32	24	5/16-18 X 3/4 SS (HEX SOCKET)	G0003059	144 IN-LBS	A	WEAR INSERTS
	4	23	10-24 X 1/4 SS (SET SCREW CUP POINT)	G0003874	N/A	A	CASE FLINGER
	12	22	3/8-16 X 1 SS (HEX SOCKET)	G0003064	252 IN-LBS	A	BOWL EXTENSION
△6△3 *	9	21	5/16-18 X 1 (HEX SOCKET ALY)	SKCS-31-18X100	300 IN-LBS	262L	ROTODIFF/GEARBOX FLANGE
	1	20	1/2-13 X 1 SS (SET SCREW FULL DOG)	G0003877	265 IN-LBS	A	FEED ACCEL BUMP
	2	19	3/8-16 X 1 SS (SET SCREW CONE POINT)	G0003876	75 IN-LBS	A	FEED ACCEL BUMP
	8	18	3/8-16 X 3/4 SS (HEX SOCKET)	G0003063	252 IN-LBS	A	CASE PLOWS
△7△6	4	17	1/4-20 X 5/8 (HEX SOCKET SST)	G0008201	144 IN-LBS	A	PILLOW BLOCK FLINGER
	8	16	3/8-16 X 1 SS (HEX SOCKET)	G0003064	252 IN-LBS	A	SPLINE HUB
	16	15	3/8-16 X 1 SS (FLAT HEAD HEX SOCKET)	G0001868	183 IN-LBS	A	PILLOW BLOCK COVER
△7△4	6	14	5/16-18 X 4 (HEX SOCKET SST)	G0008200	NO TORQUE	A	FLINGER COVER
	8	13	1/4-20 X 1 SS (HEX SOCKET)	G0003056	83 IN-LBS	A	PULLEY SHEAVE
	1	12	1/4 X 1 PIN (STEEL)	PP1361	N/A	680L	S/E BEARING HOUSING
	6	11	5/16-18 X 3 SS (HEX SOCKET)	G0003062	144 IN-LBS	A	S/E SEAL HOUSING
	8	10	3/8-16 X 1 SS (HEX SOCKET)	G0003064	252 IN-LBS	A	S/E BOWL HEAD
	2	09	PLASTIC CAP	G0003467	N/A	N/A	S/E BOWL HEAD
	4	08	1/8 NPT X 3/4 SS (GREASE FITTING)	G0003513	N/A	N/A	S/E BOWL HEAD
△5△3	2	07	5/16-18 X 1/2 SS (SET SCREW CUP POINT)	G0005508	N/A	262L	S/E BOWL HEAD
	4	06	1/4 X 1 1/4 PIN (STEEL)	G0001744	N/A	680L	S/E BOWL HEAD
	4	05	3/8-16 X 1 SS (HEX SOCKET)	G0003064	252 IN-LBS	A	L/E SEAL HOUSING
	8	04	3/8-16 X 1 1/2 SS (HEX SOCKET)	G0003066	252 IN-LBS	A	L/E BEARING HOUSING
	1	03	5/16 X 5/16 X 3 KEY	G0003872	N/A	N/A	L/E BOWL HEAD
*	4	02	5/16 X 1 PIN (STEEL)	PP1362	N/A	680L	L/E BOWL HEAD
	12	01	3/8-16 X 1 1/4 SS (HEX SOCKET)	G0003065	252 IN-LBS	A	L/E BOWL HEAD
	QTY	ITEM	HARDWARE REQUIRED	PART NO# (PER PC)	TORQUE SETTING	LUBRICANT	REFERENCE PART

△1
NOTES:
1) MATERIAL: (HEX SOCKET BOLTS)
ALLOY STEEL – TENSILE STRENGTH 190,000 PSI MINIMUM (HEAT TREATED)
STAINLESS STEEL – TENSILE STRENGTH 80,000 PSI MINIMUM
2) QUANTITY LISTED IS PER ROTATING ASSEMBLY
3) * A) ITEMS 02 & 21 QTYS ARE (4) FOUR FOR UNITS PRIOR TO SERIAL NUMBER CF000272
* B) ITEM 02 QTY IS (2) TWO & ITEM 21 QTY IS (6) SIX FOR UNITS WITH SERIAL NUMBERS IN THE RANGE OF CF000272 TO CF000678
△5 * C) ITEM 02 QTY IS (0) ZERO & ITEM 21 QTY IS (9) NINE FOR UNITS WITH SERIAL NUMBERS ABOVE CF000679
** D) ITEMS 35 & 37 ARE NOT REQUIRED AFTER UNIT CF000678
△3 *** E) ITEM 33 TO BE USED WITH ROTODIFF ASSY 107/D6V
ITEM 39 TO BE USED WITH ROTODIFF ASSY 1071

REV	CHANGE	CKD	DATE
8	ADDED GEARBOX VIEW; MOVED BALLOON 34 TO GEARBOX VIEW; SEE MODEL SPACE & RECORD COPY FOR REVISIONS 1 THRU 7.	CCS	5/12/09

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TITLE: CENTRIFUGE ROTATING ASSEMBLY
HARDWARE PARTS LIST

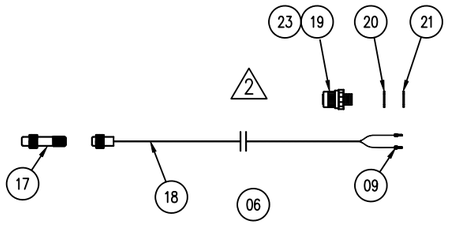
DWN NVB | CKD | DATE 3/21/01 | SCALE 1:5 | REV 8

SHEET SIZE C | Y | DWN | FC | CKD

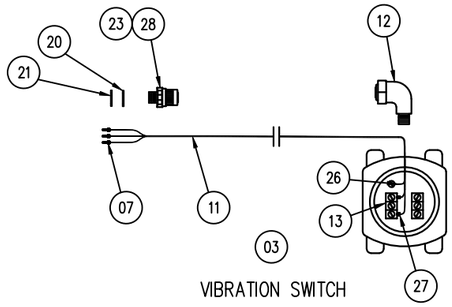
DRAWING NO. 14894-00

DERRICK® CORPORATION
590 DUKE ROAD BUFFALO, NY 14225 U.S.A.

CENT, MAN, BOM

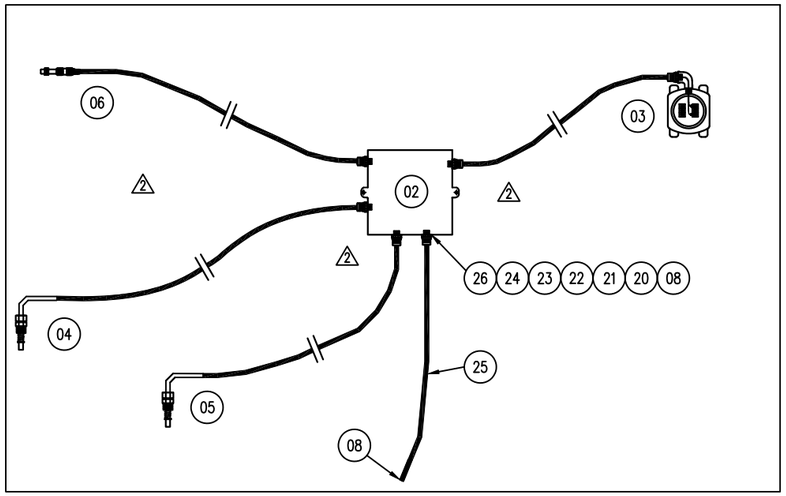


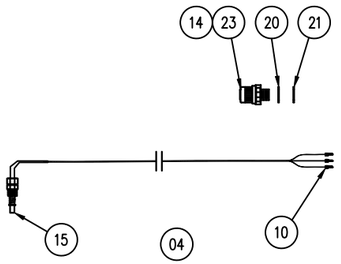
SPEED SENSOR



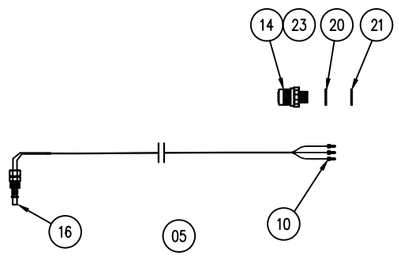
VIBRATION SWITCH

2





LIQUID END RTD SENSOR



SOLID END RTD SENSOR

					ITEM	PART NAME	PART NUMBER
			1		28	FITTING,CORD–.500 NPT X .500–.625 DIA	PP1383
			3		27	RING TERMINAL 16AWG	PV14–6RN–M
			1	1	26	HEAT SHRINK GREEN/YELLOW (21 INCHES)	G0012517
				1	25	CABLE, INTRINSIC 18AWG–18C BLUE (162 INCHES)	G0008403
				1	24	FITTING,CORD–.500 NPT X .375–.500 DIA	G0001687
1	1	1	1	1	23	PLASTIC INSULATED BUSHING .050	PP1290
				1	22	FERRULE,WIRE–14AWG BLU	G0002648
1	1	1	1	1	21	LOCKNUT .050 304 SST	G0013391
1	1	1	1	1	20	SEALING GASKET .50	G0009340
1					19	FITTING,CORD–.500 NPT X .125–250 DIA	G0002711
1					18	CABLE, SPEED SENSOR 2 METER (CUT DOWN TO 36 INCHES)	G0007862
1					17	SPEED SENSOR, 12MM EMBEDDABLE	G0007861
	1				16	RTD SENSOR, BEARING, 316SS 136" WIRE PVC COAT	G0008090
		1			15	RTD SENSOR, BEARING, 316SS 41" WIRE PVC COAT	G0008089
	1	1			14	FITTING, STRAIGHT .500" NPT .250 – .375	G0004418
			1		13	VIBRATION SWITCH	G0003015
			1		12	FITTING, 90 DEGREE ELBOW .500" NPT .500 – .625	G0001713
			1		11	CABLE,MARINE SHIPBOARD–GEXOL INSUL #16–3 COND (55 INCHES)	G0007163
	3	3			10	FERRULE 26AWG	G0012492
2					09	FERRULE 24AWG	G0008931
				36	08	FERRULE 18AWG	G0003538
			3		07	FERRULE 16AWG	G0004464
				1	06	SPEED SENSOR ASSY, LENGTH IS 36"	16615–06
				1	05	SOLID END RTD ASSY, LENGTH IS 136"	16615–05
				1	04	LIQUID END RTD ASSY, LENGTH IS 41"	16615–04
				1	03	VIBRATION SWITCH ASSY, LENGTH IS 55"	16615–03
				1	02	JUNCTION BOX, SENSOR ELECTRONICS ASSY	16584–01–005
					01	DE–1000 BASE ELECTICAL COMPONENT KIT	16615–01
QTY					ITEM	PART NAME	PART NUMBER

REV	CHANGE	BY	CKD	DATE
9	REVISE ITEM 21 (WAS G0008575)	BJR JWC	JWC	07/09/13
8	REVISE ITEM 06 (WAS SHOWN AS 82"), REVISE ITEM 18 DESCRIPTION TO BE CLEARER	JWC JF	JWC	07/16/12
7	REVISE 02 (WAS 16584–01), REVISE 12 QTY (WAS 2), REVISE 22 (WAS G0007994), ADD ITEM 28, REVISE 25 DESCRIPTION (WAS 193"), REVISE FRONT MEW FOR ACCURACY	JWC JF	JWC	06/11/12
6	REVISE PARTS LIST TO INCLUDE MORE DETAILS, SEE MODEL SPACE FOR ORIGINAL PARTS LIST FOR REV 1–5	JWC JFS	JWC	02/23/12
5	REVISE ITEMS 15 & 16 (WAS G0008126 AND 8127)	JWC JFS	JWC	09/01/10
4	DELETE ITEMS 23 AND 24 DUPLICATES OF 18 AND 20	JWC JFS	JWC	08/25/09
3	REMOVED ITEM 08, WAS PP1383, CHANGED ITEM 07 (WAS G0002377), ITEM 13 WAS 60" ITEM 14 WAS 148", ADDED ITEMS 23 & 24	KWJ JWC	JWC	10/21/08
2	REVISED LOCATION OF SENSORS AND CONNECTION POINTS, ADDED ITEMS 18, 19, 20, 21, 22 CHANGED ITEM 12 (WAS TBS–2521)	JWC JFS	JWC	08/27/08
1	ADDED SPECIFIC LENGTHS TO PART NAME	KWJ JFS	JWC	4/23/08

REF: G.A. #14738–00–004
REF: W.S. #14394–00–010

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TITLE: PARTS LIST FOR VFD DE–1000 BASE SENSOR SYSTEM

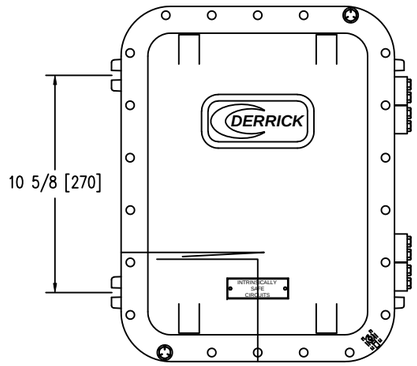
DWN MS | CKD JFS | DATE 02/14/07 | SCALE NONE | REV 9

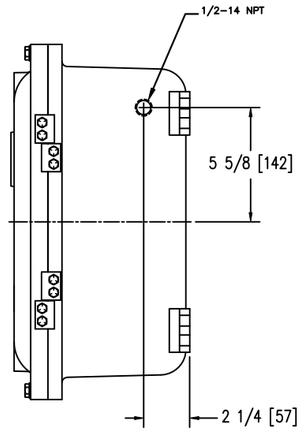
SHEET SIZE C | N | DWN | F C | CKD

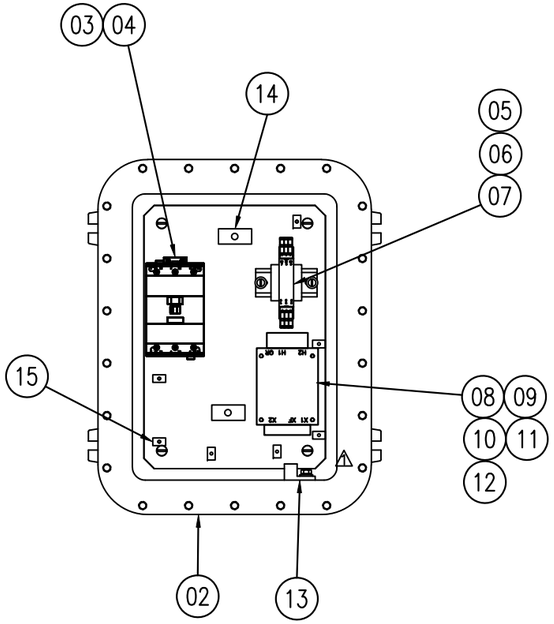
DRAWING NO. 16615–00

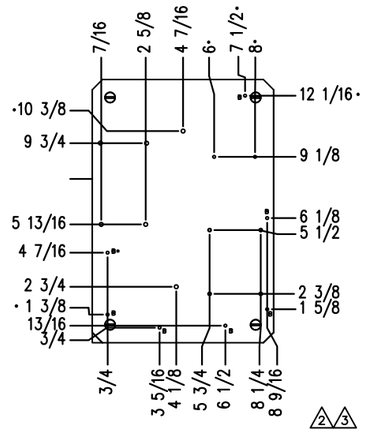
DERRICK® CORPORATION
590 DUKE ROAD BUFFALO, NY 14225 U.S.A.

BOM,CENT,MAN







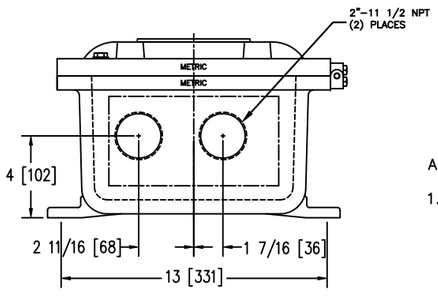


ALL HOLES 10-32 TAPPED HOLE
EXCEPT WHERE NOTED. (12 PLACES)
B= 8-32 TAPPED HOLE (7 PLACES)

ADALET
A SCOTT FETZER COMPANY

TBD

NAMEPLATE DETAIL



ADALET ASSEMBLY NOTES:

1. INSTALL METRIC STAINLESS BOLT AND WASHER AS SHOWN.

QTY	ITEM	PART NAME/DESCRIPTION	PART NO.
	15	WIRE TIE BASE SMALL	PAN-TM3S10-C
2	14	WIRE TIE BASE LARGE	G0003519
1	13	GROUND LUG-250MCM DUAL ONE MTG HOLE MECH	G0008896
1	12	TIME DELAY FUSE, 1.25 AMP 250V	G0002926
2	11	TIME DELAY FUSE, 0.5AMP 600V STYLE ATQR	G0004195
	10	NOT USED	
	09	NOT USED	
2 1	08	TRANSFORMER, CONT-480V PRI/120V SEC 100VA	G0002481
2 1	07	SWITCH AMP, BARRIER,INTRINSIC	G0009286
2	06	END CLAMP FOR 35 MM DIN	G0007012
1	05	DIN RAIL, 35 X 7.5MM X 1.5" ZPL STL	G0006292
2	04	NOT USED	
2 1	03	CONTACTOR, IEC-100A (AC-1) 600V W/120V COIL	G0008060
1	02	ENCLOSURE, EP-10"X14"X6" NEMA 4X,7&9 AL SA1123	G0008929
X	01	ASSEMBLY	16622-01-005

REF GA #14738-00-007
REF W.S.# 14394-00-018
REF CEP.# 16545-00-002

REV	CHANGE	CKD	DATE
3	REVISE SEVERAL HOLE DIMENSIONS ON BACK PLATE.	JWC JFS	12/13/10
2	ADD BACK PANEL DRILLING PATTERN, REVISE ITEM 08 (WAS G0008401) DELETE 09 & 10 REVISE ITEM 03 (WAS G0008425) ,REVISE ITEM 07 (WAS G0008526), DELETE ITEM 04	JWC JFS	08/31/10
1	ADD BACK PANEL TO LAYOUT	JWC JFS	10/08/08

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TITLE: XP ELECTRICAL CONTROL PANEL FOR VFD DE-1000 WITH SKID 460/480 V

DWN JFS | CKD MJS | DATE 05/23/07 | SCALE NTS | REV 3

SHEET SIZE C | F N | DWN JWC 08/20/08 | CKD JFS 08/20/08

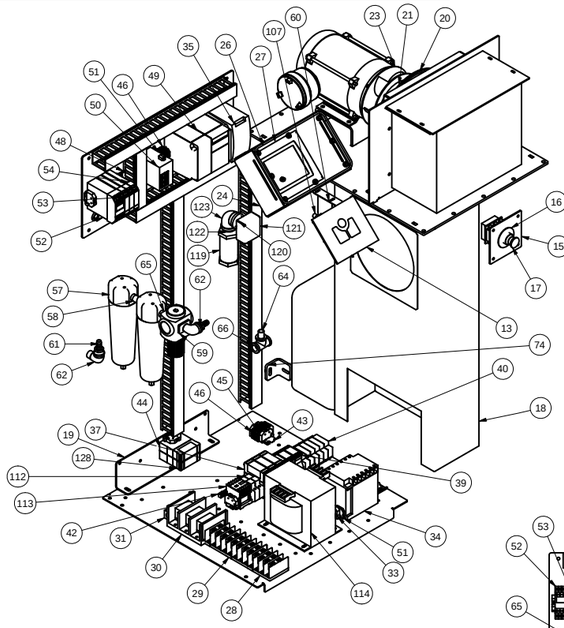
DRAWING NO. 16622-00-005

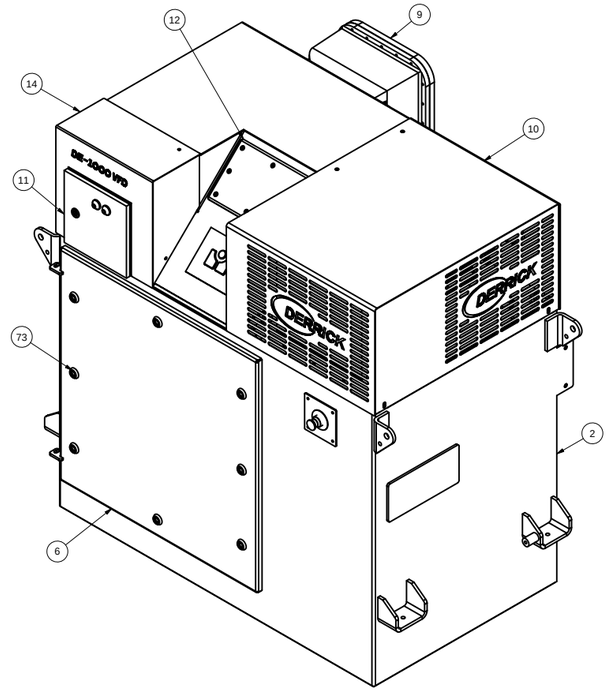
DERRICK® CORPORATION
590 DUKE ROAD BUFFALO, NY 14225 U.S.A.

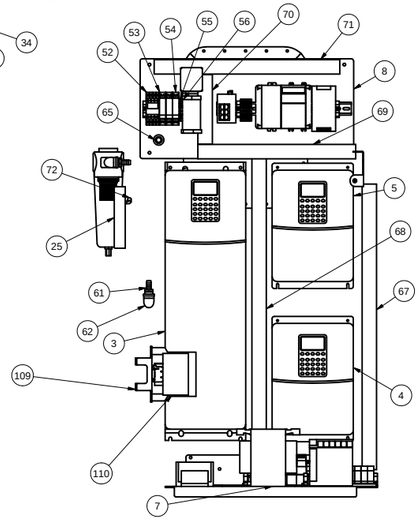
CENT, BOM, PUR

ITEM	QTY	DRAWING NUMBER	DESCRIPTION
1	X	16545-01-006	ASSEMBLY COMPLETE
2	1	16396-01-007	ENCLOSURE ASSEMBLY
3	1	G0008359	DRIVE, 50 HP 460 60 HZ
4	1	G0007241	DRIVE, 20 HP 460 60 HZ (CONVEYOR)
5	1	G0008360	DRIVE, 15 HP 460 60 HZ (FEED PUMP)
6	1	16400-01-006	DOOR ASSEMBLY
7	1	16404-01-009	COMPONENT PANEL (BOTTOM)
8	1	16404-02-009	COMPONENT PANEL (UPPER)
9	1	16622-01-006	EXPLOSION PROOF ELECTRICAL ASSEMBLY WITH HEATER
10	1	16401-01-005	CONDENSER COVER
11	1	G0007865	PURGE UNIT W/ RELIEF VALVE
12	1	15181-01-001	HMI PROTECTIVE COVER
13	1	17006-01	MOUSE ASSY, VFD CENTRIFUGE KIT
14	1	16401-01-006	PURGE COVER
15	1	17365-01	E-STOP MOUNTING PLATE
16	1	G0007244	NAME PLATE, EMERGENCY STOP
17	1	G0005325	BUTTON, EMERGENCY STOP
18	1	G0009813	AIR CONDITIONER, 3200 WATT 460/60/3
19	1	16404-03-009	COMPONENT PANEL (LOWER)
20	1	15197-01-003	INLET CONE EXTENSION
21	1	G0002604	INLET CONE
22	1	G0007588	AIR CONDITIONER COOLING MOTOR
23	1	G0002603	FANWHEEL, 8" BACKWARD CURVED
24	1	16405-01-001	HMI MOUNTING BRACKET
25	1	G0008006	RELIEF VALVE (SERIAL # OF PURGE REQUIRED) REPLACEMENT ONLY (INCLUDED IN 11)
26	1	G0004364	O-RING, PROTECTIVE COVER
27	1	G0007976	OPERATOR INTERFACE, 120 VAC- PROGRAMMED
28	3	G0008891	BLOCK, PWR DISTR-3 POLE 2/0-#14
29	3	G0008892	BLOCK, PWR DISTR-1 POLE 2/0-#14 ADDER
30	1	G0008889	BLOCK, PWR DISTR-3 POLE #6-350MCM 310A
31	1	G0007213	GROUND LUG, INCOMING
32	1	G0012063	DIN RAIL, 35MM X 8
33	13	G0008507	TERMINAL BLOCK END BARRIER
34	1	G0003504	SURGE SUPPRESSOR, 120V 60HZ
35	1	G0003552	POWER SUPPLY, 24VDC-5 AMP
36	3	G0007585	HOLDER, FUSE-CUBE STYLE 100 AMP 600V
37	3	G0007583	FUSE, CUBE STYLE-100 AMP 600V
38	3	G0003486	FUSE HOLDER, CUBE STYLE-60 AMP 600V
39	3	G0003484	FUSE, CUBE STYLE-40 AMP 600V
40	2	G0007214	FUSE BLOCK, 30 AMP 3P CLASS CC
41	2	G0012056	DIN RAIL, 35MM X 14 1/2
42	1	G0005309	GROUND BUS BAR
43	3	G0009516	DIN RAIL, 35MM X 2 1/2
44	2	G0012311	FUSE, 60 AMP 600V CLASS J
45	2	G0008563	TERMINAL END PLATE-ORANGE- 4 PT
46	15	G0008562	TERMINAL BLOCK, 4 COND-GRAY- 4 PT
47	1	G0012559	REDUCER, 2" X 1 1/2"
48	1	G0007984	DIN RAIL, 35MM X 6
49	1	G0007228	PLC, COMPACTLOGIX
50	1	G0007231	ETHERNET SWITCH, 6 PORT
51	4	G0009324	TERMINAL BLOCK GROUND, 4 COND-GRN/YEL
52	1	17244-01	BARRIER, INTRISIC SAFE-SPEED SENSOR
53	2	17325-01	BARRIER, INTRISIC SAFE-RTD SENSOR-PROGRAMMED
54	1	G0009286	BARRIER, INTRISIC SAFE-VIBR SENSOR
55	2	G0008571	TERMINAL BLOCK, 2 COND-GRN/YEL
56	1	G0008544	TERMINAL BLOCK END PLATE-ORANGE
57	1	G0003565	AIR FILTER HOUSING, DX ELEMENT- ORDER G0002301 ELEMENT
58	1	NPLE-50X200S-4	1/2 X 2 PIPE NIPPLE, SST
59	1	G0009927	AIR REGULATOR
60	1	17420-01	A/C THERMOSTAT MOUNTING BRACKET
61	5	G0008004	1/2 X 1/2 HOSE BARB
62	3	G0008003	1/2 90 DEG STREET ELBOW, BRASS
63	1	IMP-116B-02X02	1/8 90 DEG STREET ELBOW, BRASS
64	1	NPLE-50-S4	1/2 CLOSE NIPPLE, SST
65	2	G0002716	1/2 X 1 1/2 PIPE NIPPLE, SST
66	2	G0009866	1/2 X 1/2 FPT PIPE TEE, BRASS
67	1	G0007338	WIRE DUCT, 1 1/2 X 2 X 30 3/4
68	1	G0009874	WIRE DUCT, 1 1/2 X 2 X 31 1/4
69	1	G0009875	WIRE DUCT, 1 1/2 X 2 X 17
70	1	G0009876	WIRE DUCT, 1 1/2 X 2 X 7 1/2
71	1	G0009877	WIRE DUCT, 1 1/2 X 2 X 20
72	1	G0009863	1/8 ELBOW, QUICK CONNECT REPLACEMENT ONLY (PART OF ITEM 25)
73	8	G0008005	DOOR LATCH
74	1	16403-01-002	A/C SUPPORT ANGLE
75	1	G0009864	TUBE, 6MM X 12" LONG
76	3	G0003493	FUSE, TIME DELAY 15A 600VAC CLASS CC
77	3	G0008792	FUSE, TIME DELAY 3A 600VAC CLASS CC
78	1	G0007230	PLC END BARRIER
79	1	G0007229	PLC POWER SUPPLY
80	1	G0007995	COMPACT FLASH MEMORY CARD
81	-	G0007252	WIRE DUCT FASTENER MOUNT
82	-	PAN-TM3S10-C	WIRE SADDLE, SMALL
83	-	G0003519	WIRE SADDLE, MEDIUM
84	1	G0007951	ETHERNET CABLE X 8 1/2 (ETH SW-PLC)
85	2	G0009873	ETHERNET CABLE X 47 (ETH SW-HMI & 15HP)
86	1	G0009871	ETHERNET CABLE X 94 (ETH SW-50HP)
87	1	G0009872	ETHERNET CABLE X 60 1/2 (ETH SW-20HP)
88	12	G0008893	TERMINAL BLOCK COVER-2/0
89	3	G0008890	TERMINAL BLOCK COVER-350MCM
90	1	G0002873	TRANSFORMER COVER
91	2	G0009839	TERMINAL BLOCK JUMPER
92	2	TBS-2535	CORD FITTING, 3/4 NPT
93	4	SHPP-100	PLUG, 1" NPT-SQ HD
94	1	G0009767	CORD ASSEMBLY, COND FAN MOTOR TO ENCLOSURE
95	1	G0009768	CORD ASSEMBLY, MAIN SUPPLY
96	1	G0009899	CORD ASSEMBLY, BOWL MOTOR TO ENCLOSURE
97	1	G0009898	CORD ASSEMBLY, CONVEYOR MOTOR TO ENCLOSURE
98	1	17382-01	CORD ASSEMBLY-INTRINSIC, PURGE SYSTEM
99	1	G0001686	FITTING,CORD-1.500 NPT X 1.188-1.375 DIA
100	1	G0008809	FITTING,CORD-1.500 NPT X .875-1.000 DIA
101	1	G0009811	FITTING,CORD-2.500 NPT X 1.500-1.800 DIA
102	1	G0003533	FITTING,CORD- .500 NPT X .250-.375 DIA 90 DEGREE
103	1	G0001687	FITTING,CORD- 500 NPT X .375-.500 DIA
104	*	G0008403	CABLE,SHIELDED-18AWG 18 COND LT BLUE (CUT 85" LENGTH)
105	1	17006-02	USB/PS2 ADAPTER AND BRACKET ASSY, VFD CENTRIFUGE-KIT
106	1	G0002300	AIR FILTER HOUSING, BX ELEMENT- ORDER G0002302 ELEMENT
107	1	G0009974	SENSOR, RTD
108	1	G0009972	RTD CORDSET,MOLDED-3M LONG 4 WIRE GREY
109	1	17423-01	HEATER/THERMOSTAT MOUNTING BRACKET
110	1	G0012047	HEATER,FAN-FLR MNT 1200W 120VAC 32-140F
111	1	G0012048	THERMOSTAT,TEMP-NO 14-122F 15A@120V
112	2	G0012010	HOLDER,FUSE-30A 1 POLE 600V MAX MIDGET
113	1	G0012012	RELAY,CONTROL 4NO 600V 120 COIL
114	1	G0012013	TRANSFORMER,CONT-2000VA 480V PRI 120V SEC
115	1	G0012008	FUSE,TIME DELAY-MIDGET 15A 240V
116	1	G0012009	FUSE,TIME DELAY-MIDGET 5A 240V
117	1	CRH-EL296	FITTING, ELBOW .75 NPT M+F
118	1	G0012062	CABLE ASSEMBLY, HEATER
119	1	G0012122	VALVE,CHECK 1" NPT FEMXFEM BRASS
120	1	G0012166	ARRESTOR,SPARK UNIV SST
121	1	G0012168	COVER, WATER/DUST
122	1	G0012167	NIPPLE,PIPE-1"XCLOSE SCHED40 304SS
123	1	S4PE-EL-100	ELBOW,PIPE-1" FPT 90 DEG 150# 304SS
124	1	G0008349	PLC BATTERY (REPLACEMENT ONLY)

ITEM	QTY	DRAWING NUMBER	DESCRIPTION
125	1	G0008214	M-F ELBOW 3/4"
126	1	CRH EL29	CORD FITTING, 90 DEGREE
127	1	NPLE-75-COND	COND NIPPLE
128	1	G0008073	HOLDER,FUSE-ULTRASAFE 60 AMP 600V 2P CLASS J
129	4	G0004286	END STOP, TERMINAL BLOCK
130	1	SHPP 200	PLUG, 2 NPT-SQ HD
131	1	G0013391	1/2" LOCKNUT
132	1	G0009340	1/2" SEALING GASKET
133	1	PP1290	1/2" INSUL. BUSHING, PLASTIC







SPECIAL TOOL: PURGE PRESSURE MEASURING KIT - G0008378

REF. W.S. # 14394-00-023

REV	DESCRIPTION	BY	DATE
8	CORRECTED BALLOON LOCATIONS FOR ITEMS 4 & 5	WS	8/1/2013
7	REVISE ITEM 45 QTY(WAS 4), REVISE ITEM 46 QTY(WAS 13), REVISE ITEM 47(WAS G0012259), REVISE ITEM 51 QTY(WAS 3), REVISE ITEM 53(WAS G0007918), REVISE ITEM 93 QTY(WAS 3), REPLACE ITEM 126(WAS G0009864), REPLACE ITEM 127(WAS G0009863), ADD ITEM 129,130,131,132,133	BJR	7/8/2013
6	ITEM 9 WAS 16622-01-005;27 WAS G0007976;33 WAS G0007012;QTY ITEM 36 WAS 5; 42 WAS G0007610;44 WAS G0012311;47 WAS CRH-RE-64;75 WAS 17006-02;84 WAS G0009966;85 WAS G0009967; 86 WAS G0009968; 87 WAS G0009967; 95 WAS 17377-01; 96 WAS 17378-01;97 WAS 17379-00; 107 WAS G0009973; ADDED ITEMS 124-128	DMM	7/2/2012
5	ADDED ITEMS 119-123	BKS	8/5/2011
4	ITEM 9 WAS 16622-01-005; 84 WAS G0007951; 85 WAS G0009873; 86 WAS G0009871; 87 WAS G0009872; 94 WAS 11881-01-025; 102 WAS G0004418; 46 QTY WAS 12; 92 QTY WAS 1; ADDED ITEMS 117 & 118; ITEM 35 PLACEMENT WAS ON 07; ITEM 41 QTY WAS 1; ITEM 47 WAS G0007980, 11" DIN RAIL; PER JWC	DJK	6/15/2011
3	ITEM 32 WAS G0008459; ITEM 41 WAS G0007983; ADDED ITEMS 108 THROUGH 116; DELETED G0003494, -2910, -2911, AND -2874.	DSD	5/13/2011
2	ITEM 64 WAS G0008008; ITEM 65 WAS G0002714; ITEM 67 QTY WAS 2; ITEM 70 QTY WAS 1; ADDED THERMOSTAT BRKT, AIR REGULATOR & ITEM 113 SENSOR, RTD	DJK BKS	5/4/11
1	ITEM 44 WAS G0005309; ITEM 57 WAS G0008526; ITEM 35 REPLACED WITH ITEM 54; ITEM 97 WAS G0002966; ADDED ITEMS 108-112	EJR	2/8/2011

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DRAWN	CCS	1/12/2011
CHECKED		
QA		
MFG		
APPROVED		

DERRICK® CORPORATION

TITLE

CONTROL ENCLOSURE ASSEMBLY
DE-1000LP EX-PROOF 460/60/3

SIZE	FILECOPY	DWG NO	REV
D	Y	16545-00-006	8

SCALE NTS SHEET 1 OF 1

CENT, MAN

SECTION 9 - INSTALLATION AND MAINTENANCE LOG

PURPOSE

This section should be used by operating and maintenance personnel to record historical information gathered during the installation and operation of the Derrick equipment. If properly kept, the log will be useful for altering maintenance intervals and intercepting trends that may indicate the need for changing operating procedures. Each entry in the log should be dated for future reference and tracking. If required, additional pages may be added to the log by copying a blank page or simply inserting ruled paper at the rear of the section.

Installation and Maintenance Notes:

INSTALLATION & MAINTENANCE LOG

INSTALLATION & MAINTENANCE LOG

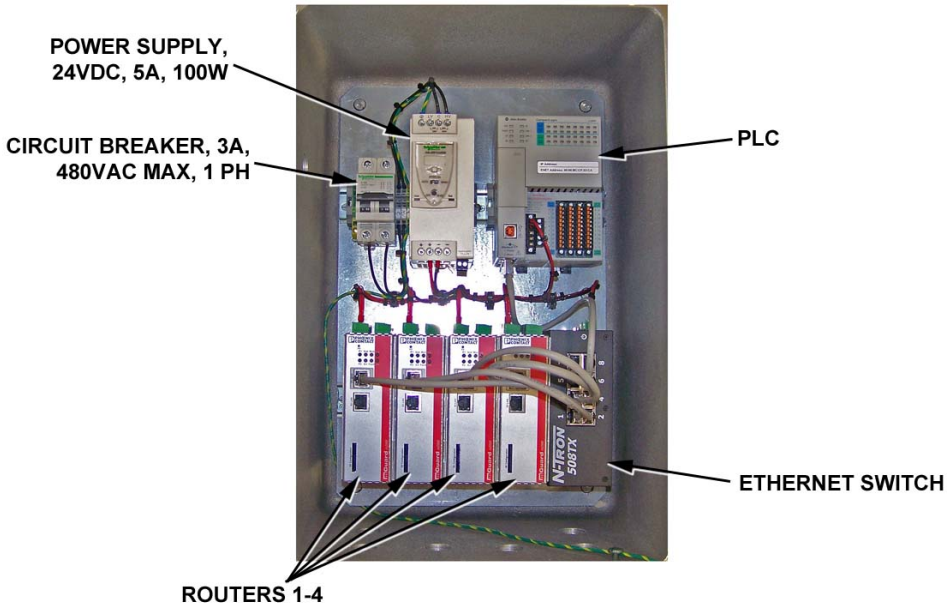
INSTALLATION & MAINTENANCE LOG

APPENDIX A - HMI SERVER SYSTEM

DESCRIPTION

This Appendix contains instructions for installing, connecting, and operating the HMI Server System, which consists of an HMI Server and Router Switchgear Box (Figure A-1). The system permits remote monitoring for the Derrick DE-7200 and DE-1000 Variable Frequency Drive (VFD) centrifuges. By connecting a customer-supplied PC or laptop computer to the server, the operator can monitor two to four centrifuges from a single location separate from the control cabinets. All monitoring features that can be displayed on the control cabinet operator panel are made available on the remote PC or laptop computer by means of a web-based interface. In addition, the system can be re-configured by Derrick to permit remote operation.

HMI Server



Router Switchgear Box

Figure A-1. VFD Centrifuge HMI Server System Components

INSTALLATION

All safety procedures included in the Operation and Maintenance manual are to be followed when installing the HMI Server System components. Installation is performed in the following sequence:

- Install server in safe area on a desktop or wall.
- Install Router Switchgear Box on a suitable wall in hazardous area.

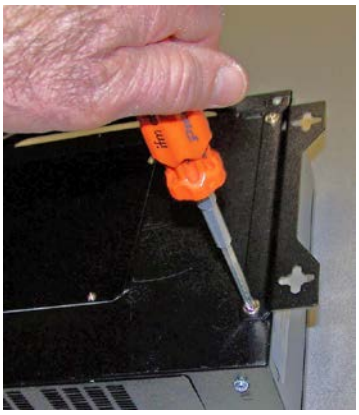
Note! If desired, Router Switchgear components mounting plate may be removed from the explosion-proof box and installed in a non-explosion proof enclosure in a safe area.

- Connect Ethernet cables between server and pc or laptop.
- Install 1” NPT cable gland in each control cabinet.
- Connect Ethernet cables between routers and centrifuge control cabinets.
- Connect electric power to circuit breaker in Router Switchgear Box.

HMI Server Installation

The HMI Server may be placed on a desktop or mounted to a wall in a non-hazardous area. Mounting brackets and rubber feet are supplied with the server to facilitate wall or desktop installation (Figure A-2). Note that the wall mounting brackets have slotted holes to permit minor position adjustment during installation.

Installing Rubber Feet for Desktop Mounting



Installing Wall Mounting Brackets

Figure A-2. Server Mounting Options

Router Switchgear Box Installation

Four mounting lugs are provided on the electrical enclosure for wall mounting. Select a mounting location that permits the front cover to be opened for accessing the interior components. Refer to drawing 17647-00 for box dimensions and mounting requirements.

Electric Power Connections

The HMI Server and Router Switchgear Box use 220/240Vac, single-phase, 50/60Hz electric power. Perform electric power connections as follows:

1. Install a 1” NPT explosion-proof cable gland in Router Switchgear Box to accept power cord.
2. Route 14 AWG (2.5mm) or larger power cable from the customer power source to the circuit breaker in the Router Switchgear Box (Figure A-3). Strip and secure cables to circuit breaker terminal.

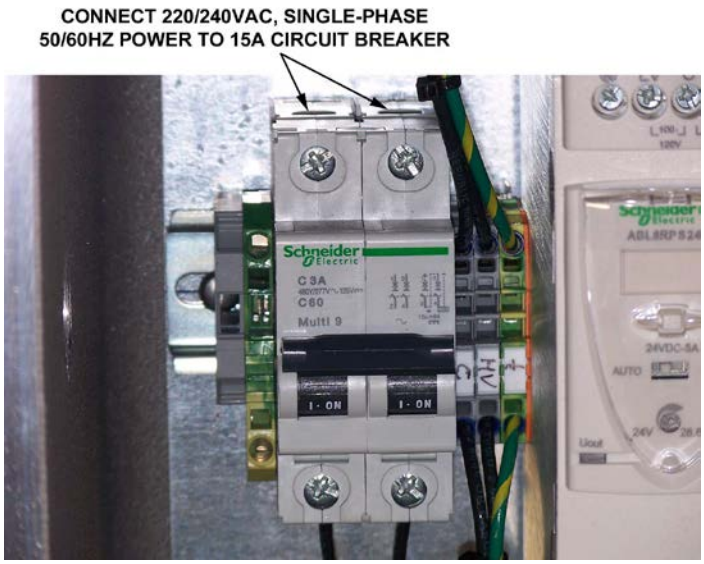


Figure A-3. Electrical Connections to Router Switchgear Box

3. Tighten nut properly on cable gland to ensure proper sealing.
4. Close and secure cover of Router Switchgear Box after completing connections.
5. Plug in HMI Server and PC power cords.

Ethernet Connections

Required Equipment

The following customer-supplied components are required for making the Ethernet connections:

Item	Purpose	Quantity
Category 5 (CAT5) or higher shielded Ethernet cable	Connections between control cabinets, HMI Server, & Router Switchgear Box	Maximum 328' (100m) each
1" NPT cable glands	Ethernet cables from each control cabinet to routers in Router Switchgear Box	1 for each centrifuge control cabinet
Explosion-proof 3/4" NPT cable glands	Ethernet & power cables into Router Switchgear Box	Up to 7 for Router Switchgear Box: 1 for Power 2 or 1 for PC 1-4 for Centrifuges
Ethernet switch/router	Interconnect HMI Server and computer	1
PC or laptop computer	Monitor up to 4 centrifuges	1-3 (supports up to 3 connections)

Server and PC Connection Requirements

An Ethernet connection must be established between the Ethernet switches in the centrifuge control cabinets and the routers in the Router Switchgear Box. Ethernet connections are also required from the HMI server to the computer and Ethernet switch in the Router Switchgear Box.

Control Cabinet Connections to Router Switchgear Box

The following procedure describes the interconnection of control cabinets with the HMI Server. Refer to drawing 18309-00 for additional assistance in making the connections, and note that cables must be no more 328' (100m) long. All cabling must be properly dressed, protected from chafing, and secured appropriately.

1. Remove the 1" NPT pipe plug from fitting at left upper left side of each control cabinet, and install a cable gland in its place.
2. Route a CAT5 cable through each cable gland to the Ethernet switch at the upper rear of the control cabinet, and connect cable to open port at upper left of switch (Figure A-4).
3. Install a customer-supplied 3/4" cable gland in a Router Switchgear Box opening for each centrifuge to be monitored.

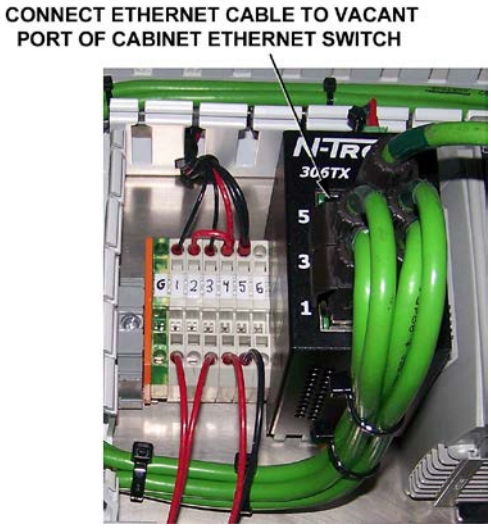


Figure A-4. Ethernet Switch Connection Port

4. Route free end of each CAT5 cable through a cable gland in Router Switchgear Box, and connect to open port of each router (Figure A-5).

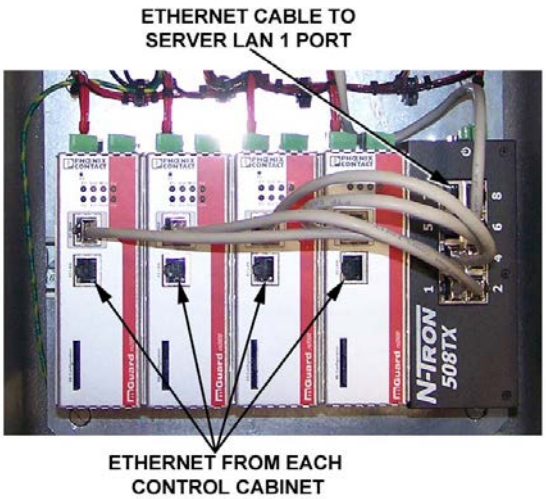


Figure A-5. Ethernet Connections to Routers

5. Connect a CAT5 cable to Ethernet switch in Switchgear Box, and connect opposite end to LAN 1 port on HMI Server (Figure A-6).
6. Tighten nuts properly on all cable glands to ensure proper sealing.
7. Connect a CAT5 cable from LAN 2 port of HMI Server to Ethernet switch port.
8. Connect a CAT5 cable from LAN port of customer-supplied computer to second port of Ethernet switch.

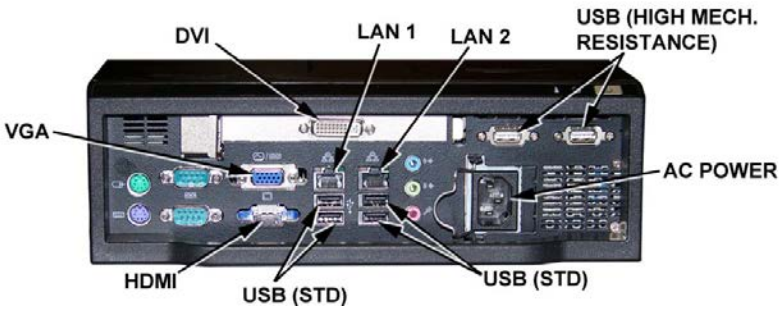


Figure A-6. HMI Server Connection Ports

OPERATING HMI SERVER

The HMI Server System permits continuous monitoring of up to four centrifuges from a single computer located in a non-hazardous area. A combination of DE-1000 and DE-7200 centrifuges may be monitored. All information displayed on the local Operation screen of each centrifuge may be viewed on the computer. System flexibility allows the operator to view all machines simultaneously or individually.

Startup and Shutdown

Both the HMI Server and Router Switchgear Box require 220/240Vac 50/60Hz power for operation. Units are turned on separately. Proceed as follows to turn on equipment:

1. Apply power to the HMI Server. PC will start up once power is applied. If PC does not start up, press power button or cycle power to PC.
2. Once HMI Server boots up, the Home screen is displayed.
3. To shut down HMI Server, simply press and release power button on Server. If Server is inaccessible, select *Exit Runtime* from the Setup screen. Next, select *Shutdown PC* on the DeskLock Launcher.

Note! If Server is shut down, restart by cycling power or pressing power button. Wait at least 30 seconds before re-applying power to restart the unit.

4. Turn off power to Router Switchgear Box to shut down unit.

Operation

If an existing network infrastructure having a DHCP server is not available to connect to LAN 2 of the HMI Server, a four-port router with DHCP capability may be used. Alternatively, the LAN 1 interface may be used on the HMI Server PC to connect to the HMI Server. If desired to connect to the LAN 1 interface, a basic 10/100 Mbps Ethernet switch will be needed. The switch would be installed between the router box and the HMI Server PC (instead of a direct connection). Additional PCs would then connect to this new customer-supplied switch.

Operation (Cont'd)

IP Address

If connecting to LAN 1, the static IP address of the PCs must be set to the following IP addresses:

PC	IP Address	Subnet Mask
PC 1	100.100.10.201	255.255.255.0
PC 2	100.100.10.202	255.255.255.0
PC 3	100.100.10.203	255.255.255.0

In addition, note that no other component may be on the network with an address between 100.100.10.1 to 100.100.10.199, as these are reserved for the HMI Server system. Addresses 100.100.10.200 to 100.100.10.255 are reserved for the customer's use.

The system may be operated from either the local HMI Server PC or a web-based program from another PC. Refer to *Installation* for connection information on both systems. Operation from either source is basically identical. When using the web-based program, a username and password are required. Depending on which LAN port is to be connected to the HMI Server, start the web-based program be entering the following information in the web browser:

For LAN port 1 - http://100.100.10.101/FTVP

For LAN port 2 - http://CentHMI0001/FTVP

Note! CentHMI0001 is identical to PC serial number, i.e., CentHMI0001, CentHMI0002, CentHMI0003, etc.

Web-Based Program

To use the web-based program, enter the following username and password:

Username - readonly

Password - read

After entering the HMI Server program, the HOME screen will appear. Make desired selection from Home screen to view a single centrifuge operation screen (Figure 1-8) or view all centrifuge operation screens side by side. The operator may then select additional option(s) from the displayed screen. Figures A-7 through A-13 show the screens that are accessible through both the web- and PC-based systems. Figure A-14 shows the DeskLock screen options.

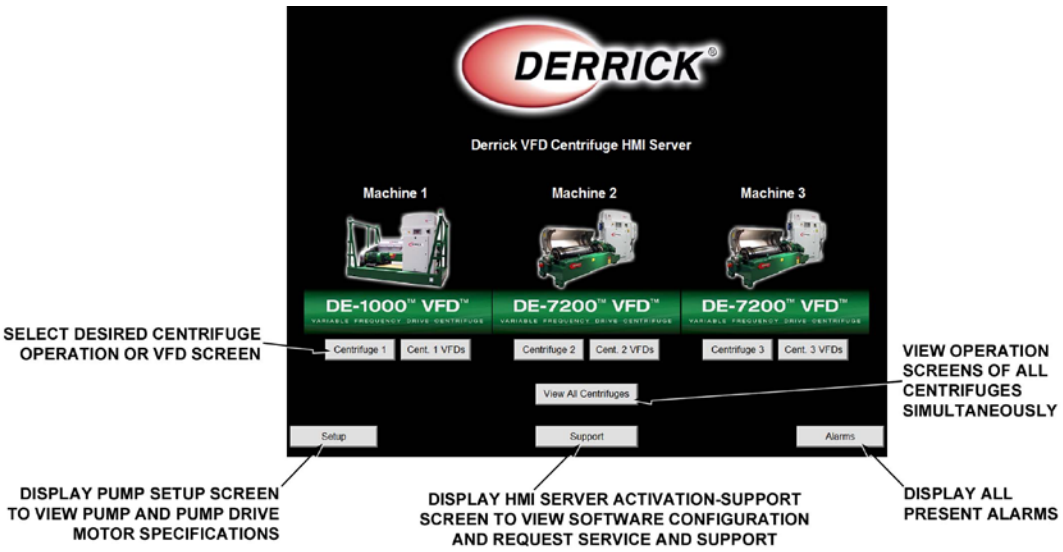


Figure A-7. HMI Server Home Screen

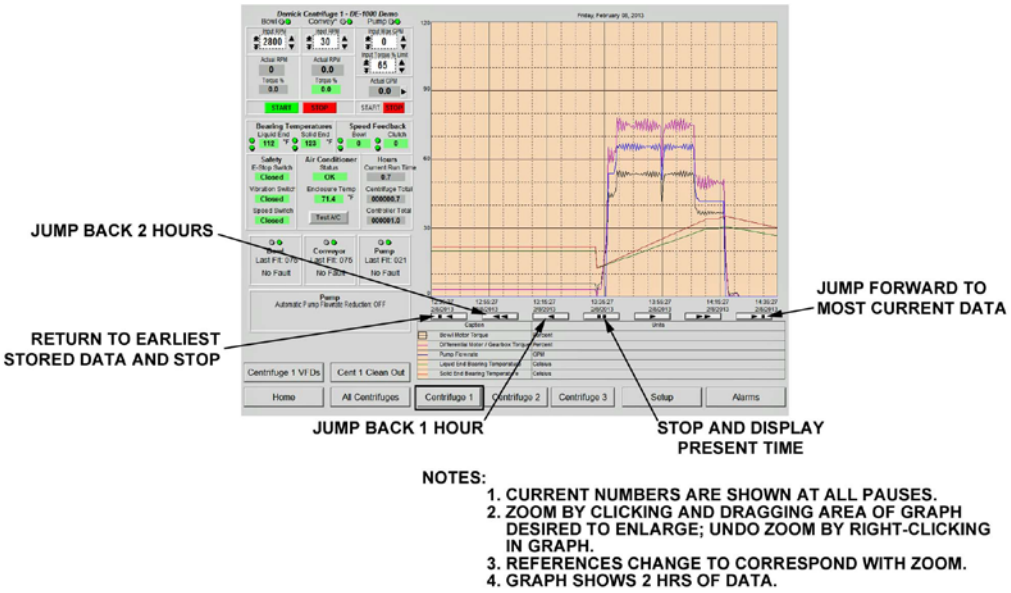

JUMP BACK 2 HOURS
RETURN TO EARLIEST STORED DATA AND STOP
JUMP FORWARD TO MOST CURRENT DATA
JUMP BACK 1 HOUR
STOP AND DISPLAY PRESENT TIME
Centrifuge 1 VFDs
Cent 1 Clean Out
Home
All Centrifuges
Centrifuge 1
Centrifuge 2
Centrifuge 3
Setup
Alarms
NOTES:
1. CURRENT NUMBERS ARE SHOWN AT ALL PAUSES.
2. ZOOM BY CLICKING AND DRAGGING AREA OF GRAPH DESIRED TO ENLARGE; UNDO ZOOM BY RIGHT-CLICKING IN GRAPH.
3. REFERENCES CHANGE TO CORRESPOND WITH ZOOM.
4. GRAPH SHOWS 2 HRS OF DATA.

Figure A-8. Operation Screen - Centrifuge 1

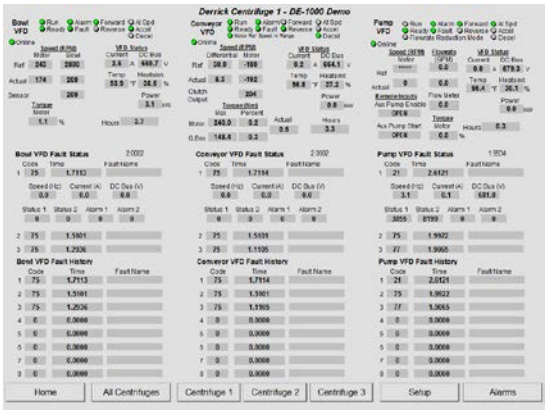


Figure A-9. VFD Screen - Centrifuge 1

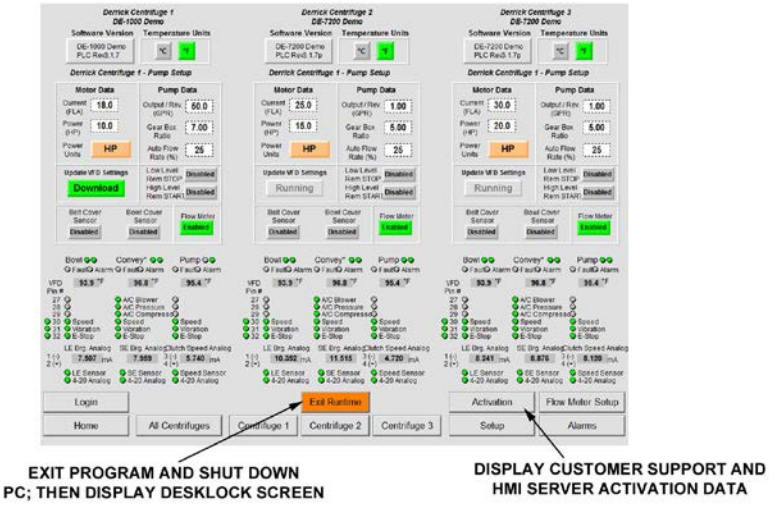


Figure A-10. Pump Setup Screen

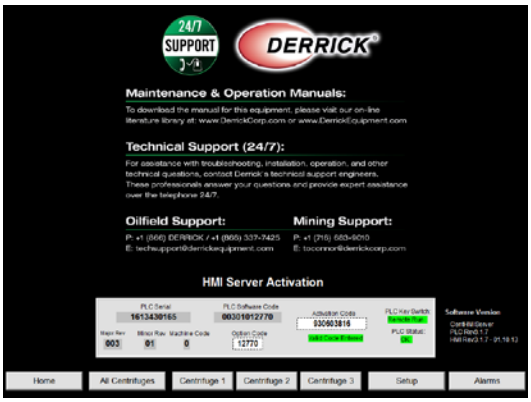


Figure A-11. Support-Activation Screen

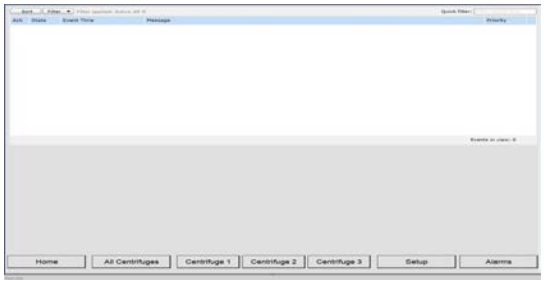


Figure A-12. Alarms Screen

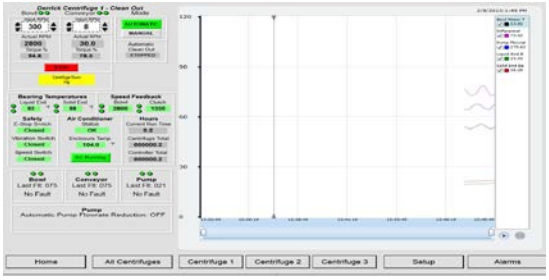


Figure A-13. Cleanout Screen

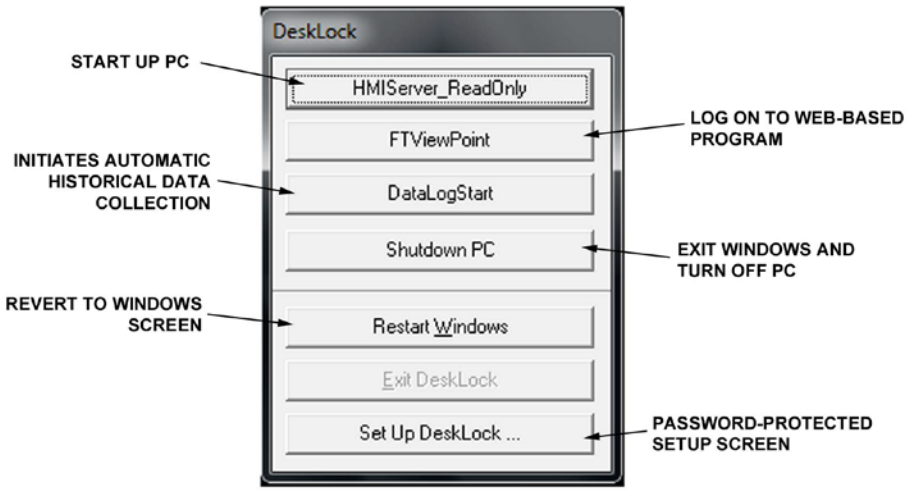


Figure A-14. DeskLock Screen

Troubleshooting Network Connectivity

The following IP addresses of all system components permit entry into the router configuration to verify that the router is communicating:

	X1 WAN Port	**X2 LAN Port**
Router 1	https://100.100.10.1	https://100.100.100.101
Router 2	https://100.100.10.2	https://100.100.100.101
Router 3	https://100.100.10.3	https://100.100.100.101
Router 4	https://100.100.10.4	https://100.100.100.101
	LAN Port #1	**LAN Port #2**
HMI Server PC	100.100.10.101	Assigned by DHCP
Activation PLC	100.100.10.100	

Use the following Network Address Translation (NAT) data to verify that connections are correct and that communication is established between the PLC and routers:

	X1 WAN Port of Router	**X2 LAN Port of Router**
PLC 1	100.100.10.10	100.100.100.10
PLC 2	100.100.10.20	100.100.100.10
PLC 3	100.100.10.30	100.100.100.10
PLC 4	100.100.10.40	100.100.100.10

To assist in troubleshooting communication defects, a customer PC may be connected as shown in Figure A-15 to ping the routers to verify communication.

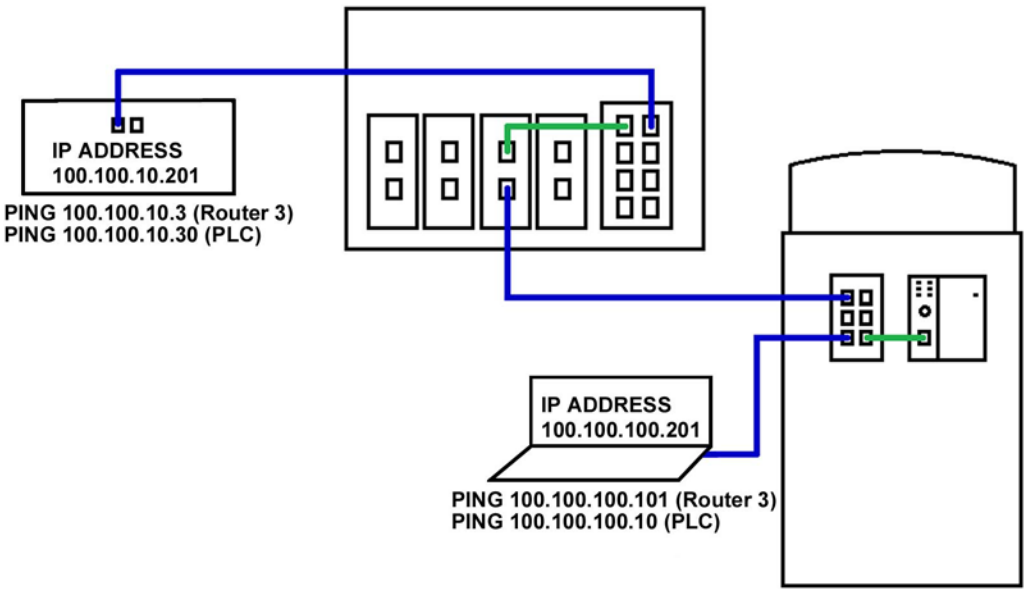


Figure A-15. Customer PC Test Connections to Ping Routers

REFERENCE DRAWINGS

Drawings included in this appendix are listed in Table A-1. These drawings are included to assist in the installation and operation of the HMI Server.

Table A-1. HMI Server Drawings

Number	Title
17647-00	Remote VFD Centrifuge HMI Server Kit With Activation for Two, Three, or Four Centrifuges
18308-00	Wiring Diagram for Remote VFD Centrifuge HMI Server Kit
18309-00	Ethernet Connection Diagram for Remote VFD Centrifuge HMI Server Kit

Document No.: PE-S-069-03-03

CERTIFICATE OF ORIGIN

Equipment:	Centrifuge
Model:	DE-1000™ GBD, DE-1000™ FHD, DE-1000™ VFD
Characteristics:	0-600VAC, 50/60Hz, 3PH

Derrick Corporation acknowledges that the above set-forth product is manufactured in the United States of America as of the data of this certificate. This certificate is governed by the applicable purchase order terms in effect at the time of Derrick Corporation's original shipment of the referenced product.

Date: 29-December-2011

Signature: Jennifer J. Polanowski
Derrick Corporation

Document No.: PE-S-009-08-00

CERTIFICATE OF QUALITY

Equipment:	Centrifuges
Model:	DE-1000™ GBD, DE-1000™ FHD, DE-1000™ VFD, DE-7200 VFD
Characteristics:	0-600VAC, 50/60Hz, 3PH

Derrick Corporation acknowledges that the above set-forth product conformed to the requirements for the applicable purchase order at the time of its original shipment by Derrick Corporation in that all construction materials and components were new and unused, were manufactured for this product, and that it was free of any known defects as to their design, material and workmanship. This certificate is governed by the applicable purchase order terms in effect at the time of Derrick Corporation's original shipment of the referenced product.

Jennifer J. Polanowski

Date: 29-December-2011

Signature: Jennifer J. Polanowski
Derrick Corporation

SHIPPING FINAL INSPECTION AND RUN TEST CERTIFICATE

Equipment:	Centrifuges
Model:	DE-1000™ GBD, DE-1000™ FHD, DE-1000™ VFD, DE-7200 VFD
Characteristics:	0-600VAC, 50/60Hz, 3PH

The product listed above was inspected and found to be in conformance with Derrick Corporation's internal coating, run test, and assembly inspection documents that were required for the type of equipment manufactured in accordance with the Derrick quality system. This certificate is governed by the applicable purchase order terms in effect at the time of Derrick Corporation's original shipment of the referenced product.

Date: 29-December-2011

Signature: Jennifer J. Polanowski
Derrick Corporation

DERRICK® CORPORATION

Doc # PE-S-036-02-06
Date: 20-January-2011

CERTIFICATE OF CONFORMANCE

Equipment:	Mining & Oilfield equipment manufactured specifically for Hazardous Location Areas including but not limited to: Flo-Line® Cleaners, Flo-Line® Primers, Agitators, Vacu-Flo™ Degassers, DE-1000™ Centrifuges, Centrifugal Pumps, Flo-Line Scalpers™ etc.
Name and Address of Manufacturer:	Derrick Corporation 590 Duke Road Buffalo, NY 14225
Rating and Principle Characteristics:	0-600 VAC, 50/60Hz, 3PH
Model / Type Ref:	Various
Additional Information:	None

This product was found to be in conformance with:

U.L. listed for hazardous locations Class I, Division 1, Groups C & D, which is similar to equipment marked as II 2G Ex d IIB T3 for Zone 1 areas. Assembled in accordance with National Electrical Code (NEC) – articles 500 thru 506 (hazardous locations) where applicable.

Additionally:

Derrick Corporation certifies that the above-listed equipment for the referenced order conformed to the requirements of the specified order at the time of its original shipment by Derrick Corporation in that: all construction materials and components were new and unused, manufactured for this equipment, and that the goods were free of any known defects as to their design, material and workmanship. This certificate is governed by the applicable purchase order terms in effect at the time of Derrick Corporation's original shipment of the above-listed equipment.

Signature: For Thomas Silvestrini